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# ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

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# ANNALS *of* SURGERY

VOL. LXXIX

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## THE TREATMENT OF PARALYSIS OF THE RECURRENT LARYNGEAL NERVE BY NERVE ANASTOMOSIS\*

BY CHARLES H. FRAZIER, M.D.  
OF PHILADELPHIA, PA.

*Preface.*—Dr. Chevalier Jackson and the writer in January, 1923, discussed the possibility of relieving that most distressing condition—bilateral paralysis of the recurrent laryngeal nerve—by a method comparable in principle to that employed so successfully in paralysis of the facial nerve. The initiative for this discussion must be accredited to Doctor Jackson, to whom has been referred for advice and treatment a number of patients, from various parts of the country, with bilateral paralysis of the recurrent laryngeal nerve following thyroidectomies.

The possibility of accidental trauma to this nerve in operations upon the thyroid gland has always been appreciated, and surgeons, in the elaboration of their technic, have endeavored to devise methods whereby the recurrent laryngeal nerve would be protected from injury. That the accident may occur in the hands of the most experienced and skilled operator has been demonstrated by the material at hand. It is not necessary for the purpose of this discussion to review the various articles dealing with this complication of thyroidectomy, suffice it to say it is not unreasonable to assume that in the majority of instances the nerve is injured, either at the inferior pole of the lateral lobe or at its passage to the inner side of the lateral lobe as it courses upwards in the groove between the trachea and esophagus. At all events, if the nerve has been resected throughout its entire course, the conditions essential for the operation to be proposed are lacking. That this may happen was illustrated in one of our cases.

Z. G. File No. 863 N. S. Diagnosis Unilateral Paralysis of the Recurrent Laryngeal Nerve: Patient was operated upon in another hospital, March, 1917, at which time all of the right lobe and possibly some of the left lobe were removed. She was referred to my clinic at the University Hospital, by Dr. Henry K. Pancoast, with an enlargement of the left lobe of the thyroid gland and a paralysis of the right recurrent laryngeal nerve. Operation was undertaken for the relief of the paralysis, but it was impossible to find any remnant of the recurrent laryngeal nerve. Apparently it had been removed throughout its course when the right lobe had been resected at the previous operation.

*Clinical Considerations.*—Complete bilateral paralysis of the recurrens

\* Read before the Philadelphia Academy of Surgery, October 1, 1923.

NOTE: Up to the time of publication, three patients have been operated upon and while sufficient time has not elapsed to make a final report, in two of them there is evidence of returning function. The record of only one of these cases is included in this contribution.

implies paralysis of the intrinsic muscles of the larynx, the constrictors, dilators and the intrinsic tensor. While this in turn rarely implies aphonia, more or less impairment of phonation usually is present, due to the paralysis of the lateral crico-arytenoid muscles and the thyroarytenoideus. It is attended also with dyspnoea more or less acute, according to whether the paralysis of the posterior crico-arytenoid muscles is complete and bilateral. If both sides are paralyzed but not yet cadaveric, the respiratory distress is such that a tracheotomy becomes a matter of urgent necessity rather than choice.

Doctor Jackson reminds me that a monolateral or bilateral paralysis of the recurrent laryngeal nerve may be present in a patient with an excellent voice—a fact which the general surgeon may not appreciate. Many surgeons have erroneously taken themselves to task for causing a paralysis, which as a matter of fact may have existed before the thyroidectomy. The erroneous inference was drawn because the patient before the operation had a perfect voice. In the goitre clinic at the University Hospital, every patient is sent to Doctor Jackson's Clinic before the operation for a report on the functional activity of the vocal cords; as a matter of protection and satisfaction to the surgeon the pre-operative condition of the vocal cords should be made a matter of record. It is often not until the lost tonus results in a cadaveric glottis that the husky "stage whisper" aphonic stage is reached. In fact, according to Jackson this stage may never be reached. In one case under his observation it has not yet occurred at the end of twenty-two years.

The terms "complete" or "total" paralysis should be used only in the condition of the larynx in which not only are the abductors, tensors and adductors paralyzed but the reflex tonus gone. (See Fig. 1.) In this total paralysis the glottic chink is wider and dyspnoea lessened; there is much air waste and the voice is very husky. Pulmonary complications may develop from absence of glottic coöperation in the bechic cycle, and

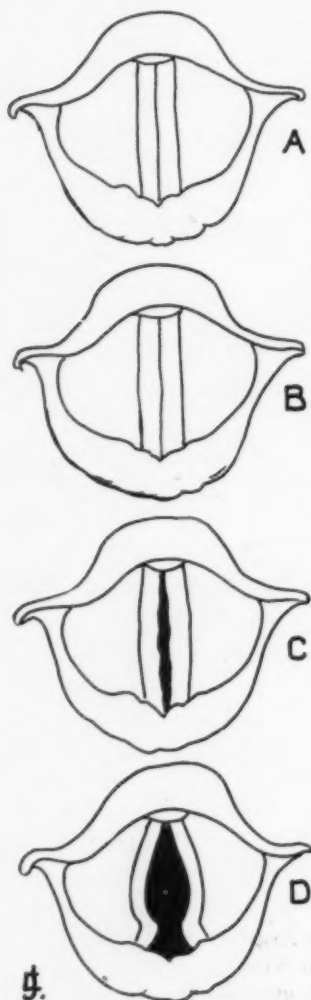


FIG. 1.—Schematic illustration of the stages of organic bilateral paralysis. A, normal phonation. B, phonation, bilateral posticus paralysis. C, phonation, paralysis has reached the tensors (thyroarytenoidei). D, final "complete" stage posticus, thyroarytenoidei, laterales all affected. In this last stage, which may never be reached, the voice is husky and there is "air waste."

the patient may even "drown in his own secretions."

In cases of subtotal paralysis, posticus paralysis of one vocal cord and partial posticus paralysis of the other, the possibility of impending suffocation should the partial paralysis of the functioning cord become complete, is such

## ANASTOMOSIS OF RECURRENT LARYNGEAL NERVE

that a tracheotomy should be performed as a precautionary measure. As an illustration of this, I may cite this case:

J. C. File No. 844 N. S.: The patient was referred to me because of a recurrent laryngeal paralysis. She had a thyroidectomy performed elsewhere on June 19, 1922. Her voice has never been normal since but is growing stronger, although her breathing has been growing more difficult. February, 1923, a laryngeal examination in the clinic of Dr. Chevalier Jackson showed one arytenoid cartilage entirely immobile, the other partially so. The left cord showed a lack of tension. February 13, 1923, a tracheotomy was performed. February 17, 1923, an examination of the lungs with tracheotomy tube open revealed certain changes from the signs found prior to tracheotomy. April 27, 1923, laryngoscopic examination showed that the patient needed only about two millimeters more abduction of her right cord to have a fairly satisfactory glottic chink.

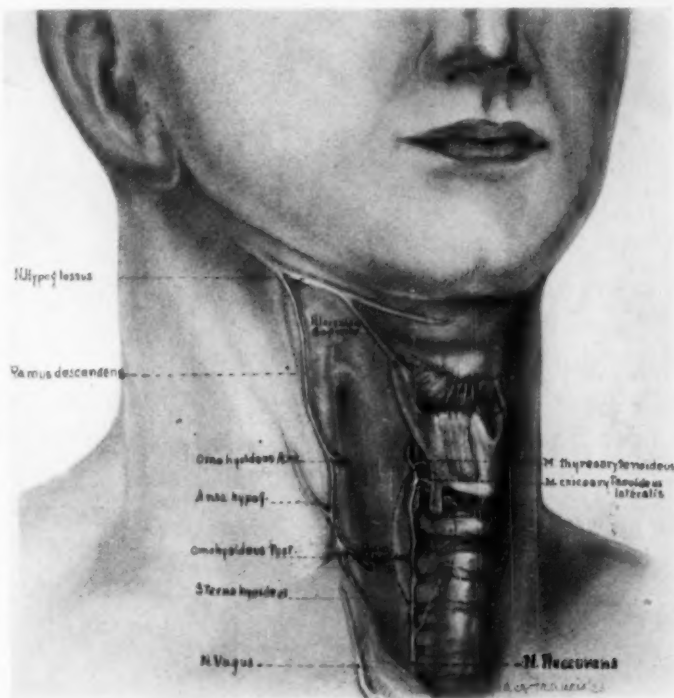


FIG. 2.—Showing the course of the recurrent laryngeal nerve and the ramus descendens hypoglossi. The inferior constrictor of the pharynx has been removed to expose the muscular branches of the recurrent laryngeal.

With a tracheotomy tube in place the danger of suffocation is, of course, averted. But the establishment of a tracheal fistula is merely an emergency measure and were there no promise of relief, no means of dealing directly with the essential lesion, the situation is tragic. In the past, Doctor Jackson has resorted to several methods, whereby the tracheal tube may eventually be dispensed with: (1) by dilatation of the glottis with bougies, resulting in outward displacement of the arytenoid cartilages; (2) by ventriculocordectomy, removing all of one vocal cord and the adjacent ventricular floor anterior to the vocal process. This ingenious method admits on inspiration an adequate supply of air, thus dispensing with the tracheotomy tube; but it does not restore the flexibility of phonation and the patient for a long time is unable

to talk except in a whisper. Eventually a fairly loud, though rough, phonation of deep pitch is obtained; but the method is crude compared to restoration of innervation without endolaryngeal operation. The shortcomings of this palliative endolaryngeal operation prompted Doctor Jackson to consider other methods of relief and at this juncture our conjoined efforts began.

*Contra-indications.*—It is necessary to be certain that there is free motility of the crico-arytenoid joint. In case of fixation of this joint, it would be hope-

less to expect any motility to be restored no matter how perfectly an anastomosis might restore innervation. The best method of determining the degree of motility of the crico-arytenoid joint is by making passive motion with a laryngeal forceps used through the direct laryngoscope.

*Physiological Considerations.*—Given a case of nerve interruption from trauma, one's first inclination is an attempt at restoration of continuity by direct end-to-end suture. This principle has long been applied, of course, to injuries to peripheral nerves and that, it may be



FIG. 3.—The recurrent laryngeal nerve and its terminal branches drawn to a larger scale, showing its terminal branches and its relation to the inferior corner of the thyroid cartilage.

applied to the n. recurrens has been demonstrated. We take it for granted, therefore, that in any operative undertaking for paralysis of this nerve the operator first investigates the possibility of repair by end-to-end suture. Assuming, as I believe will be the case in some instances, that this operation is not feasible, because the nerve lesion is too extensive, what other operative procedure is applicable? Nerve anastomosis is the first to come to mind. For this purpose a nerve predominantly motor in function is desirable. In



#### ANASTOMOSIS OF RECURRENT LARYNGEAL NERVE

the operative treatment of facial paralysis the n. hypoglossus and n. accessorius have been chosen. For the n. recurrens I at once chose the r. descendens hypoglossi.

It would seem that the r. descendens hypoglossi, both from anatomical

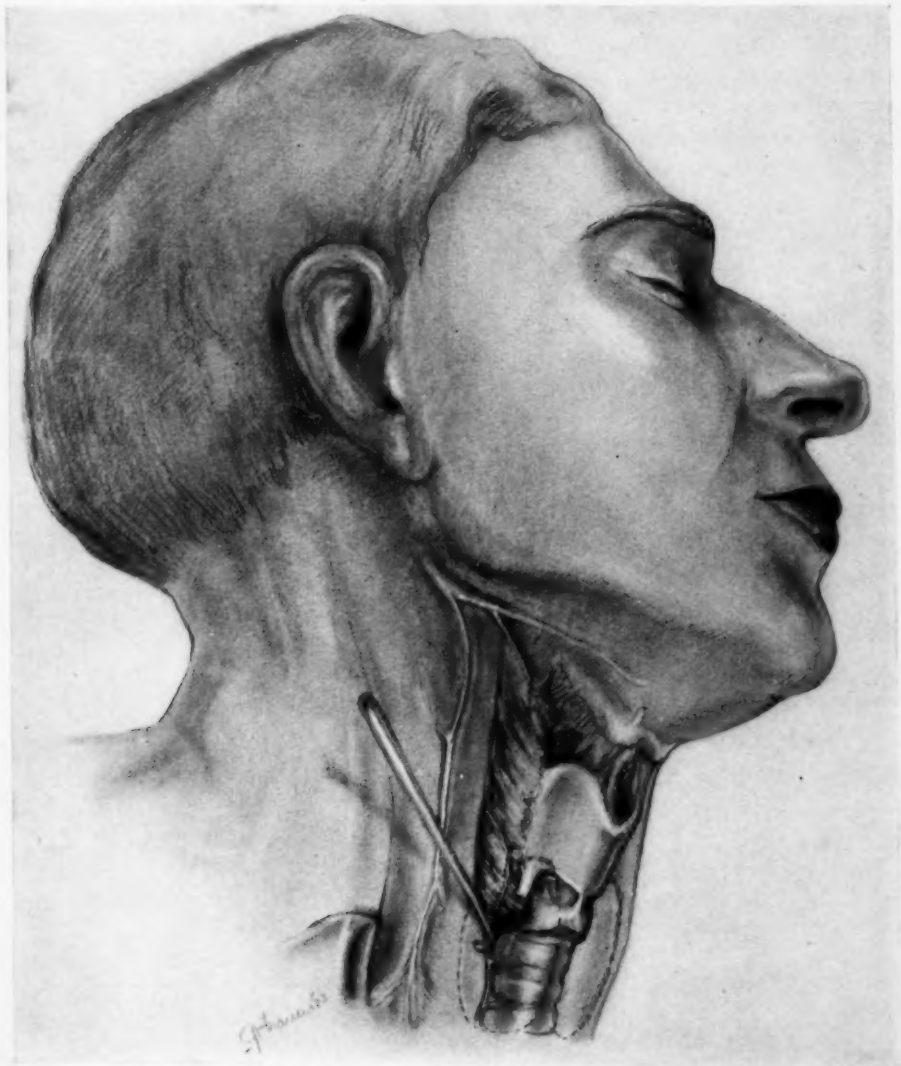


FIG. 4.—Showing relationship of recurrent laryngeal nerve to the inferior constrictor of the pharynx and the inferior corner of the thyroid cartilage.

and physiological considerations, for our purpose would be ideal. Situated not too far from the n. recurrens, readily exposed on the sheath of the carotid vessels and of sufficient length to make possible its transposition to the peripheral stump of the injured nerve, the r. hypoglossi descendens in its anatomic relations offers all that one could ask for.

While we know little or nothing of the physiologic process whereby the

cortical centre for a given movement accomplishes its purpose through a new peripheral connection, as when the n. hypoglossus is implanted into the n. facialis, the fact remains that by this process the cortex finds a way to act and voluntary motion is restored. One has but to recall the patient's ability to close the eye or whistle after a hypoglosso-facial anastomosis. Without any knowledge of the physiological *modus operandi*, whereby the cerebral cortex assumes this new function, writers on this subject frequently refer to the process as one of reëducation. But whatever may be the nature of the process, it would seem reasonable to assume that the more alike the old and

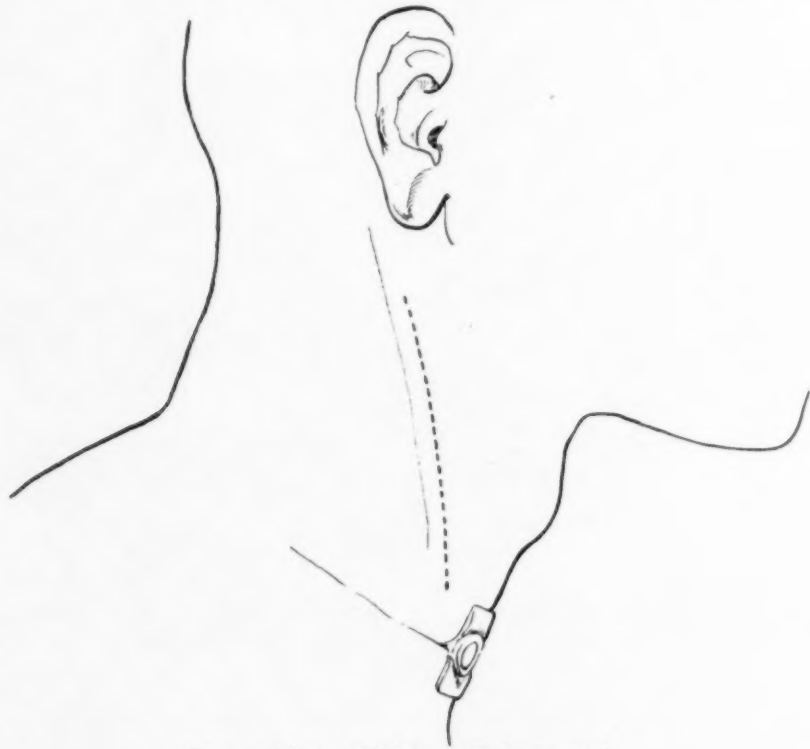


FIG. 5.—Relation of incision to tracheotomy tube.

the new, the normal and the assumed function of a given cortical centre, the greater the likelihood of its performing its newly assigned duties. Or, to put this thought in other words, the nearer the cortical centres presiding over the movements under consideration, the greater the possibility of one centre assuming the function of another. It is true, is it not, that the functions of the muscles supplied by the n. recurrens and the r. descendens hypoglossi are alike in this respect, namely that the muscles they supply, that is both the intrinsic and extrinsic muscles of the larynx are physiologically a part of the same apparatus. If, therefore, this be true, viewed from the physiological angle, the r. descendens hypoglossi would be the nerve of choice. Not only should it be chosen on anatomical and physiological grounds, but because the residual paralysis of the sternohyoid and sternothyroid muscles, which the

## ANASTOMOSIS OF RECURRENT LARYNGEAL NERVE

r. descendens hypoglossi supplies, is a matter of no very great consequence either from the cosmetic or functional standpoint. In this respect there is a striking difference between the r. descendens hypoglossi and the n. accessorius or n. hypoglossus, either of which one may use for facial paralysis. If the n. accessorius is employed, the resulting paralysis of the trapezius and sternocleidomastoid is not without its discomforts and disability; if the n. hypoglossus, the resulting hemiatrophy of the tongue, while not interfering either with speech or deglutition, sometimes disturbs the patient's vanity. As a

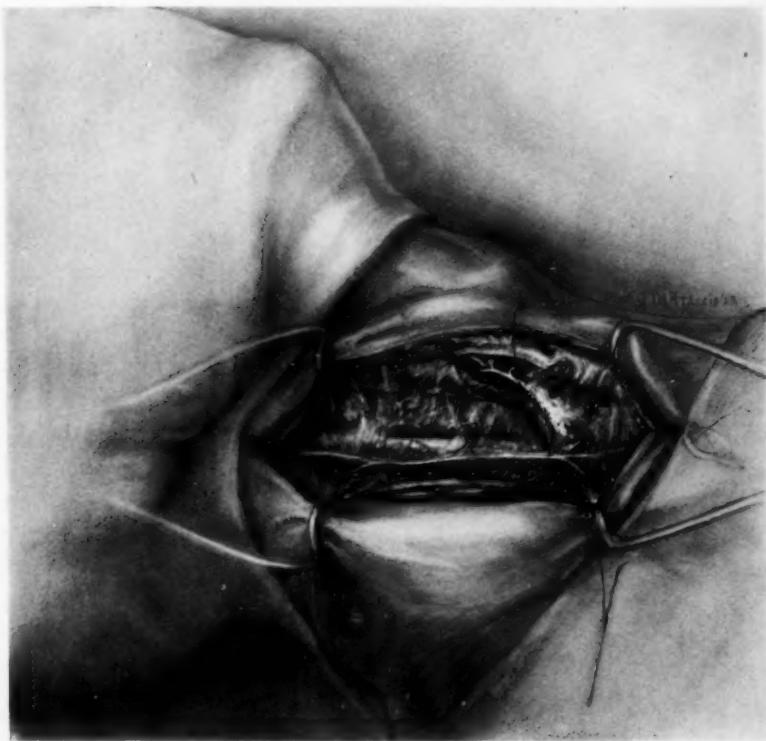


FIG. 6.—A single suture introduced in both nerves before section of either.

matter of fact hemiatrophy of the tongue may be prevented by suturing the n. descendens hypoglossi to the peripheral stump of n. hypoglossus.

While the return of voluntary motion is an accepted fact, after a faciohypoglossal anastomosis, can the same be said of involuntary or subconscious movements? I have yet to see the case in which the complicated involuntary or expressional movements are restored after a faciohypoglossal anastomosis. This *a priori* would seem a matter of very practical moment, when considering a method of restoring function to the vocal cords. We enter at once into the realm of function other than voluntary. Looking for a muscle movement analogous to that of the vocal cord movement, as in the act of inspiration, we find one not unlike it in the action of the constrictor muscles of the pharynx, but there is no instance of paralysis of these muscles which, so far as I know,

function has been restored by any surgical procedure, that is by any transfer of nerve impulse from one nerve to another, as in the customary fascio-hypoglossal anastomosis. Whether the involuntary act of winking might come within the category of movements under discussion, is an open question. This movement, of course, is governed by muscles supplied by the facial nerve but, curiously enough, I have no record of an observation or an inquiry into the return of this movement after a successful suture of the hypoglossal

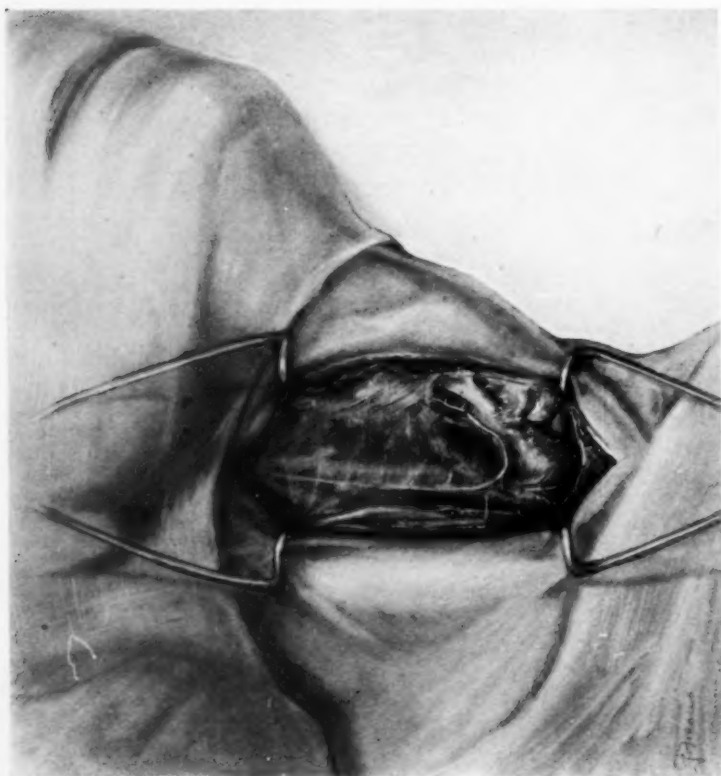


FIG. 7.—The central segment of the r. descendens hypoglossi, united by a single suture to the peripheral segment of the r. hypoglossi.

to the facial nerve. I find, however, an observation by Kennedy (Philosophical Transactions of the Royal Society of London, Series B, vol. ccii, pp. 93-163) who, in a case of facial spasm, sutured the spinal accessory to the facial nerve and 470 days after the operation Kennedy noted that "winking as a reflex movement was

quite efficient." This is a very significant and quite pertinent observation.

Whether function would be restored to muscles engaged in an involuntary or subconscious movement would depend chiefly upon whether the movement was initiated by a peripheral or central stimulus. In this particular, movement, *i.e.*, contraction of the dilators in respiration, the stimulus is peripheral, and since the peripheral mechanism has in no wise been disturbed, it is not unreasonable, accepting our premise, at least to admit of the possibility of a return of this involuntary movement after a properly executed nerve anastomosis. The proof of the pudding, however, is in the eating, and we must wait developments in the cases already operated upon.

*Technical Considerations.*—After these rather theoretical considerations,



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let us turn to the steps of the operation itself. We contemplate an end-to-end suture between the r. descendens hypoglossi and the peripheral segment of the n. recurrens. A brief reference at this point to the regional anatomy is pertinent. One can visualize the course of the recurrent laryngeal nerve in its normal relationships (see Figs. 2 and 3) and I call attention to the relationships of the nerve above the superior pole of the thyroid gland, especially to the lower border of the inferior constrictor of the pharynx behind which the nerve passes before its bifurcation. We must assume that as a rule from the superior pole of the lateral lobe down, the n. recurrens will be entangled in cicatricial tissue, resulting from the previously performed thyroidec-tomy, from which it would be difficult, if not impossible, to disengage it. It is essential, therefore, that some anatomical guide be selected, which will direct one to the nerve above the level of the lateral



FIG. 8.—Photograph of patient showing scar of incision along anterior border of the sternocleidomastoid muscle.

lobe or the stump of it. My studies in the anatomical laboratory in material kindly placed at my disposal by Dr. John C. Heisler, led me to choose the inferior cornu of the thyroid cartilage (Fig. 4) as the most constant and readily localized anatomical guide. This process and the inferior constrictor of the pharynx which is attached to the inferior cornu and the adjacent surface of the thyroid cartilage are the important anatomical landmarks, and one may see the n. recurrens dividing at this level into two branches, one to supply the inferior constrictor and one to the intrinsic muscles of the larynx.

Once the peripheral portion of the nerve has been uncovered and identified, the remainder of the operation is plain sailing. Even with the directions as given for finding the peripheral segment of the nerve, the task is not an easy one and a number of dissections should be made in the anatomical laboratory before attempting the operation in the clinic.

*Steps of the Operation.*—1. *Anæsthesia.* It must be recalled that there is *in situ* a tracheotomy tube which cannot even temporarily be removed. The administration of the anæsthetic through the tracheal tube is not practicable for obvious reasons. Hence, the operation must be performed under local anæsthesia. (Novocain-adrenalin.)

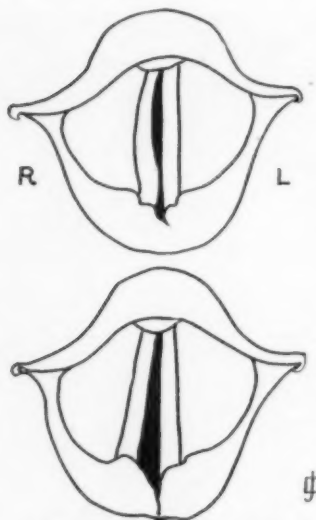


FIG. 9.—Schematic illustration of the shape of the glottis and position of the cords before and after anastomosis of the right n. recurrens with the right n. descendens, showing improvement in tension, tonus and glottic lumen. Mirror view. Case of bilateral recurrent paralysis complicating cervical goitre. The upper illustration shows the condition before operation. The right cord (R) is cadaveric.

2. *Incision.* It is to be recalled, also, that there is the scar of the collar incision from the original thyroidectomy plus the tracheal fistula. To minimize the incidence of wound contamination from tracheal fistula, the incision should be as far away from the median line as is consistent. To meet all the requirements an oblique incision is made along the anterior border of the sternocleidomastoid muscle. (Fig. 5.)

3. Identification of peripheral segment of the n. recurrens. This dissection is carried out according to the instructions already given. (See technical considerations.)

4. Identification of the ramus descendens hypoglossi. The nerve is readily identified as it descends on the anterior surface of the sheath of the carotid vessels.

5. Introduction of single epineural suture of arterial silk in both nerves while in continuity, that is before either is bisected. The point at which the suture should be introduced in the ramus descendens hypoglossi should be determined by careful measurements. A point should be selected, which after transposition will enable the suture to be tied without any

tension whatsoever and preferably above the point at which are given off branches to the omohyoid, sternohyoid and sternothyroid muscles. (Fig. 6.)

6. Bisection of nerves and tying sutures. (Fig. 7.)

7. Wound closure. There is a potential source of infection from the tracheal fistula which must never be lost sight of throughout the operation. After the incision is made, wound draperies should be used to protect both the margins and the deeper planes of the wound. Unnecessary wound trauma must be avoided by clear, sharp dissection and before wound closure hæmostasis should be *absolute*. The wound itself is closed with tier sutures, the cutaneous margins with Michel clamps.

8. After-care. The toilet of the tracheal fistula should be entrusted to a special attendant. Small gauze pads should be applied beneath the flange of the tracheal tube and changed as often as they become soiled. A strip of gauze half an inch wide is sufficient to protect the operative wound. The smaller the dressing, the less likely contamination by continuity from the tracheal fistula.

*Report of Case.*—M. H., File No. 1570 N. S., referred to the Neurosurgical

## ANASTOMOSIS OF RECURRENT LARYNGEAL NERVE

Service at the University Hospital, by Dr. Chevalier Jackson and Dr. John C. Heisler.

In another clinic a thyroidectomy had been performed in 1917. Following this the patient complained of shortness of breath and difficulty in breathing. The dyspnoea became more distressing and in December, 1922, a tracheotomy was performed by Dr. Gabriel Tucker. A laryngeal examination at that time showed almost complete bilateral paralysis of the vocal cords. In June, 1923, Doctor Jackson referred the patient to the Neurosurgical Clinic for an anastomosis of the r. descendens hypoglossi to the n. recurrens.

Operation June 29, 1923. End-to-end suture of the peripheral section of the recurrent laryngeal nerve to the descendens hypoglossi. The operation was performed under local anaesthesia. Through an oblique incision following the anterior border of the right sternocleidomastoid muscle the region was exposed and the stump of the recurrent laryngeal found from 2 to 3 cm. below the lower margin of the thyroid cartilage. Evidently it had been severed at the previous operation just above the isthmus. The descendens hypoglossi was readily found and divided at the proper level and the two segments united with a single arterial silk suture. The wound healed by first intention.

In two weeks the patient was discharged from the hospital with instructions to report to Doctor Jackson for observation.

September 20, 1923. Doctor Jackson examined the patient and wrote me as follows: "Mirror examination shows the glottic chink on deep inspiration to be about twice as wide as before operation. There is more movement in the cord and while the excursion is only slightly greater, it is, I think, sufficient to be unmistakable."

Encouraged by the positive evidence of returning function fifty-two days after operation, the patient returned to the Clinic at the University Hospital for a nerve suture on the left side November 7, 1923.

Operation November 13, 1923. Proceeding under local anaesthesia, an incision was made, as at the first operation, along the edge of the sternocleidomastoid muscle. What remained of the recurrent laryngeal nerve was found just at its point of bifurcation into terminal branches beneath the inferior constrictor of the pharynx. For adequate exposure it was necessary to divide this muscle. The r. descendens hypoglossi was then isolated and divided at a point sufficiently far down to admit of its apposition to the recurrens without tension. Apposition was effected with two epineural arterial silk sutures. Wound closure without drainage. (Fig. 8.)

November 26, 1923. Doctor Jackson submitted this report: "A very encouraging feature of the improvement is the restoration of tonus and tension. The right thyroarytenoideus, which was apparently motionless before the operation, is now quite active. With restoration of tension and tonus, the crescentic form of the cordal edge has been replaced by a normal margin. The patient notices a decided improvement, subjectively, in the laryngeal air-way." (Fig. 9.)

It is too soon of course to expect any restoration of function in the left side, but the continued signs of returning function as recorded in Doctor Jackson's several reports, gives promise of an eventual recovery.

## BENIGN TUMORS OF THE BREAST. ENCAPSULATED ADENOMA

A BRIEF SUMMARY OF THEIR CLINICAL AND PATHOLOGICAL FEATURES

By JOSEPH COLT BLOODGOOD, M.D.

OF BALTIMORE, MD.

**SYNOPSIS.**—The more common tumors of the breast. Multiple tumors. Multiple encapsulated adenoma. Single encapsulated adenoma. Single encapsulated adenoma clinically malignant. Palpation of encapsulated adenoma. Palpation of larger encapsulated adenomas. Aberrant adenoma. Sarcoma in intracanalicular myxoma. Differential diagnosis between small encapsulated adenoma and sarcoma. Encapsulated adenoma microscopically suspicious of cancer. Ultimate results in patients operated on for encapsulated adenoma, without the removal of the breast. Adenoma in pregnancy and lactation. Operations upon the breast during pregnancy and lactation. Exploratory incision and excision of benign tumors of the breast. First method of exploratory incision. Second method of exploratory incision. Third method of exploratory incision. Plastic closure. Conclusions.

The more common tumors of the breast are the *encapsulated adenoma*, some types of *chronic cystic mastitis* (the most frequent of which is the blue-domed cyst), and fully developed carcinoma. The *scirrhous* carcinoma largely leads the soft *medullary* carcinoma.

Other lesions of the breast, both benign and malignant, are relatively infrequent.

In teaching students, both before and after graduation, and in reviewing one's own experience for the purpose of improving methods for the recognition of the benign from the malignant, both clinically (based on history and palpation) and pathologically (based on the gross and microscopic appearance at the exploratory incision), one should bear in mind the common occurrence of these three great groups and first master them.

**Multiple Tumors.**—(Figs. 1 and 2.) I employ the designation A to mean a single tumor in one breast, B a single tumor in both breasts, C multiple tumors in one breast, D multiple tumors in both breasts.

When the letter E is placed after A, B, C, or D, it indicates that the single, or the multiple, tumors are indefinite.

Multiple definite tumors in the groups, B, C, and D, are rarely malignant, and, if so, in my experience, always incurable. I have recently checked this most carefully. Therefore, if one can palpate a definite tumor in each breast, or multiple definite tumors in one or both breasts, a mistake in diagnosing *benign* will never do any harm. To completely excise one or both breasts, or even to perform the complete operation for cancer on both sides, would be an unnecessary mutilating operation and should not be done without exploring one of the tumors in each breast and ascertaining their pathological nature.

Personally, I have never observed a definite single tumor in each breast.



## BENIGN TUMORS OF THE BREAST

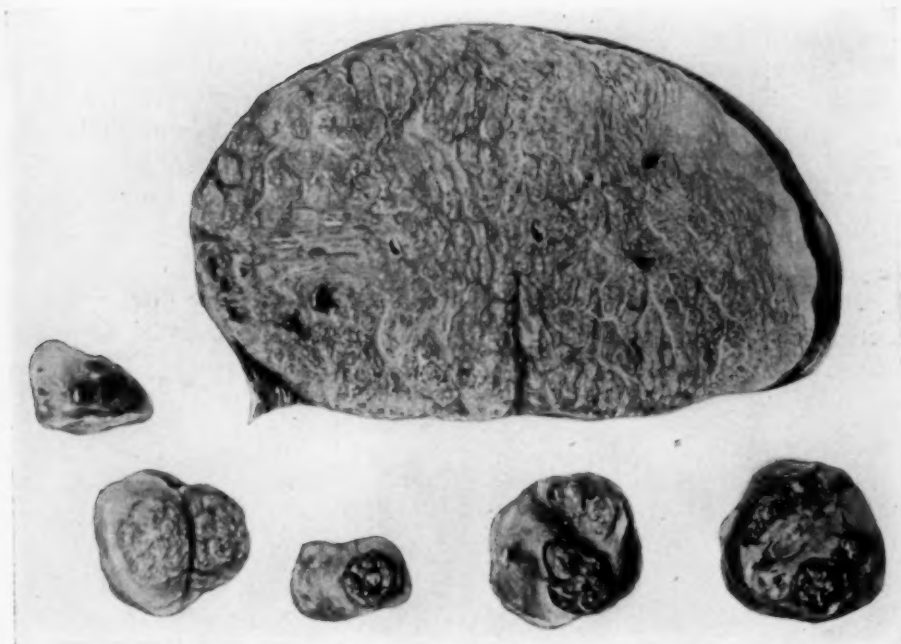


FIG. 1.—Pathol. No. 9627. Multiple adenoma removed from one breast; all encapsulated; the larger tumor is of the fibroadenoma type, the smaller represents an example of each type, fibroadenoma, intracanalicular and cystic adenoma. From original painting.



FIG. 2.—Pathol. No. 9627. On inspection unilateral hypertrophy of left breast in a girl aged thirteen. On palpation one large and many small movable tumors in left breast (see Fig. 1) and many small, movable tumors in right breast. Operation: Removal of the larger and some of the smaller tumors in the left breast. Result: Ten years later the remaining tumors have disappeared.

or definite multiple tumors in one or both breasts to be malignant, unless there was definite clinical evidence of malignancy.

The more common multiple tumors are the encapsulated adenoma and the blue-domed cyst, and for such lesions, complete removal of the breast is not necessary. The larger, or the growing, or the painful tumors may be removed. My records show that too many breasts have been sacrificed for multiple tumors in one or both breasts. These women run no more risk of cancer, and perhaps less risk, than women in whose breasts no lumps can be palpated.

*Multiple Encapsulated Adenoma.*—(Fig. 3.) There are three types of adenoma of the breast—*fibroadenoma* [82 cases] (sometimes called *periductal adenoma*), *intracanalicular myxoadenoma* [198 cases], and cystic adenoma

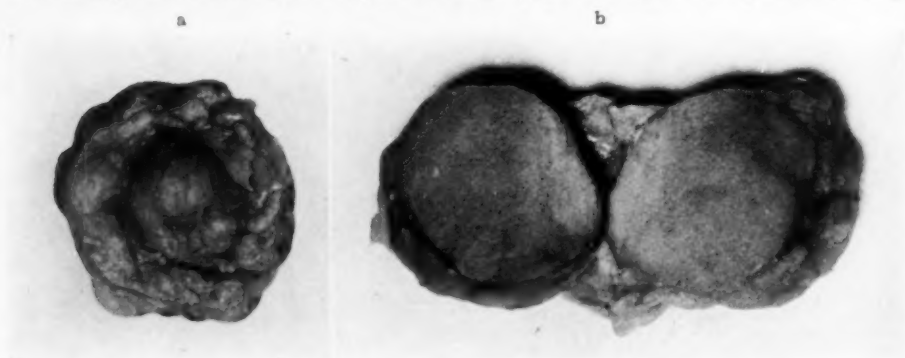


FIG. 3.—a. and b. Pathol. No. 21193. Typical encapsulated adenoma projecting like a dome above the surrounding breast—the appearance one gets at the exploratory incision. The dome is gray, not blue. For appearance of bisection see Fig. 3-b. Pathol. No. 21193. The tumor in Fig. 3-a bisected. Note the distinct capsule and the zone of breast removed with the tumor. The tumor is of the fibroadenoma type and resembles somewhat normal breast at puberty. It has less stroma and more parenchyma. See Fig. 4 for microscopic picture.

(22 cases). The first two varieties are far more frequent than the cystic adenoma. One will observe about 22 cystic adenomas to 280 of the other two types. The cystic adenoma is rarely multiple, the other two varieties are quite frequently multiple.

Multiple adenomas have been observed at any age, but are distinctly more common at puberty and before twenty-five years of age.

In the majority of cases the multiple tumors belong to one type, but not infrequently two, or even three, types may be present. There is no objection to the removal of the larger, the growing or the extremely painful tumor. It is never necessary to remove the breast or the breasts, and in many cases in which all the tumors have not been removed, their disappearance has been noted.

*Single Encapsulated Adenoma.*—When palpation finds but one definite tumor, and the patient is over twenty-five years of age, cancer must always be considered. A small encapsulated adenoma buried in breast tissue or situated in a large fatty breast may palpate like a small infiltrating scirrhus.

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Then, again, circumscribed carcinoma, especially when buried in breast tissue, or of deep position in a fatty breast, cannot be distinguished from an encapsulated adenoma. The earlier a patient seeks advice after first feeling the tumor, the more frequently one palpates benign tumors suggesting malignancy, and malignant tumors suggesting benignancy. Therefore, every surgeon should be on his guard. The most important points are: *first*, never to consent to any delay; *second*, always to operate in a hospital and prepare the patient for the complete operation for cancer; *third*, whether you explore the tumor, or excise it for diagnosis, always be prepared for the immediate chemical or thermal cauterization of the wound. I prefer pure carbolic acid and alcohol and a fifty per cent. solution of zinc chloride to the cautery.

Less than one week ago an experienced surgeon, one of my own students, a teacher of surgery and surgical pathology in a medical school, was so certain that the palpable single tumor was benign that he allowed the patient to persuade him to remove it

under local anæsthesia in his office. After its removal and gross bisection, he was horrified to find that it suggested malignancy, but he was not in a position to proceed with the complete operation. Fortunately microscopic study demonstrated the tumor to be a *non-encapsulated benign adenoma* and not a carcinoma.

In my own clinic I have the greatest difficulty in getting older and more experienced internes to remember to prepare for immediate chemical cauterization when a breast tumor is explored for diagnosis.

As a matter of fact, every single tumor of the breast in a woman over twenty-five years of age, in which the operator concludes that it is not of a

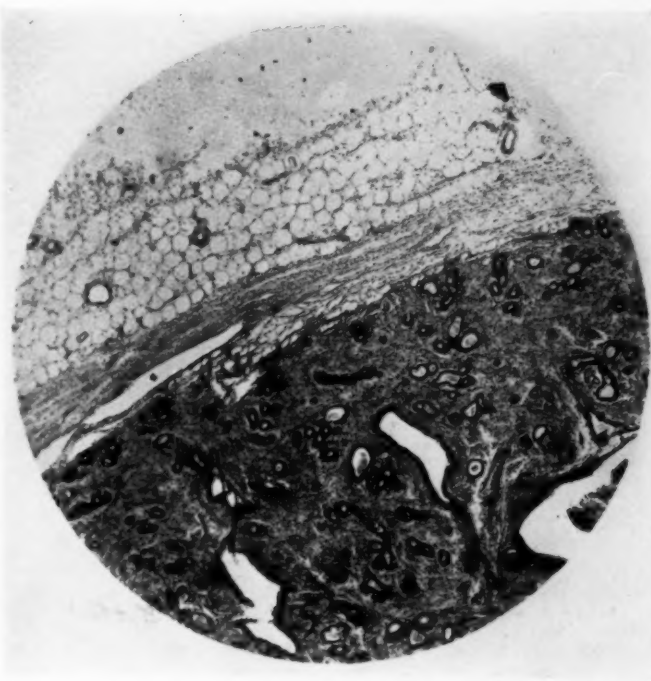


FIG. 4.—Pathol. No. 21193. Microscopic section (low power) of fibroadenoma shown in Fig. 3. The breast beyond the capsule is very fatty. The parenchyma in the tumor has no normal lobules with developed acini.

character to justify the complete operation without exploration, must be looked upon as potential cancer and be explored.

*Single Encapsulated Adenoma, Clinically Malignant.*—(Fig. 5.) My records show that encapsulated adenomas of all types are so rarely associated with retraction and fixation of the nipple, with atrophy of the subcutaneous fat, dimpling and fixation of the skin, that if the complete operation were per-

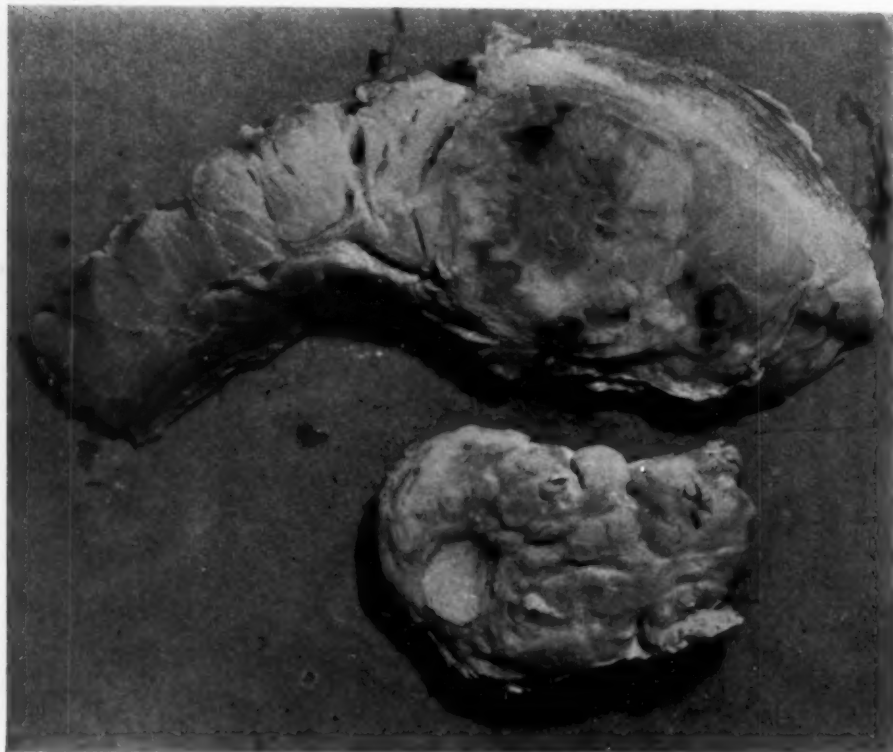


FIG. 5.—Pathol. No. 15983. Section through encapsulated adenoma (clinically malignant) and the surrounding breast. This patient, an adult woman at the menopause, had a known movable tumor of many years' duration. After a trauma, it grew from the size of a twenty-five-cent piece to that of a fifty-cent piece. There was atrophy of the subcutaneous fat and slight fixation of the skin. The complete operation for cancer was performed. Exploring the tumor after operation demonstrated edema outside the capsule. Microscopic section of the tumor (Fig. 6) shows no evidence of carcinoma or sarcoma. The glands show no metastasis, and the patient is well more than five years since operation.

formed in all such cases, very few women would be mutilated. Nevertheless these clinical signs of malignancy now and then do occur with encapsulated adenoma. It has been my rule, that when the tumor has the palpation of an encapsulated adenoma or a cyst, and the free mobility of a benign tumor, I am apt to explore the tumor, even when there is a suggestion of dimpling of the skin or atrophy of the fat, or slight fixation or retraction of the nipple. *This is especially true if the little tumor is in the nipple zone.*

More frequently have the clinical signs of malignancy been observed when the encapsulated adenomas have been multiple and the malignant signs have



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been present over one of the tumors. This is a very important thing to remember, because this knowledge will save an unnecessary mutilation of the patient. I have just noted under the heading Multiple Tumors, that they are usually benign, and if malignant never curable. Therefore, if there are multiple tumors and one of them clinically suggests malignancy, it is quite justifiable to explore this tumor.

*Palpation of Encapsulated Adenoma.*—These tumors (of the size of a pea, or a bean, or from the size of a ten-cent piece to that of a silver dollar) are usually recognized as benign by the majority of surgeons. The most characteristic feature is their free mobility, no matter whether they are situated outside the breast, in the periphery, in the midzone, or in the nipple central area. Now and then they are felt in the axilla. They can be moved about like a marble beneath the skin. A malignant tumor rarely, if ever, has this free mobility, and, of course,

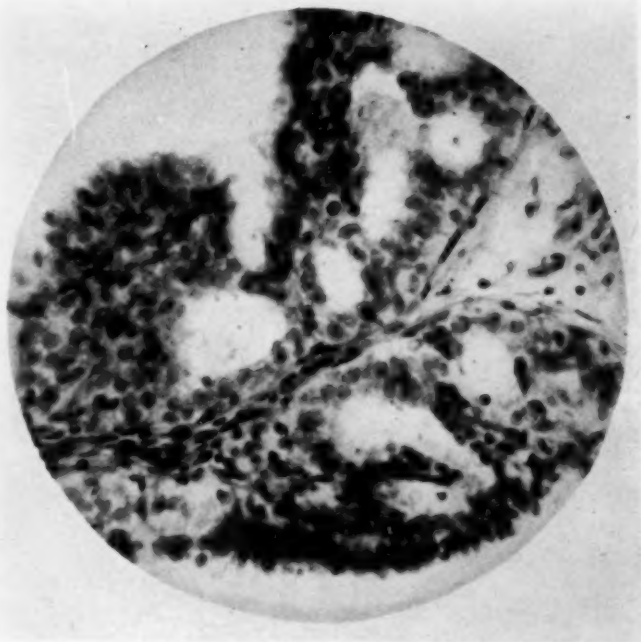


FIG. 6.—Pathol. No. 15983. Microscopic picture (high power) of tumor shown in Fig. 5. A papillary cystadenomatous area. The majority of the tumor resembled Fig. 4.

encapsulated adenomas, do not always show it. The shape of the adenoma varies. But if one can palpate the tumor and it is freely movable, and spherical, it cannot be distinguished from a cyst. More often, however, the adenoma is not spherical, but somewhat lobulated, now and then like a mulberry. When we come to consistency, some of them are hard and firm, but never of the hardness of scirrhus cancer. Many are elastic and not infrequently, especially the intracanalicular myxoma, are doughy and semi-fluctuating.

It is very important, right here, to record the fact that a small, buried scirrhus cancer surrounded by oedematous breast tissue may give to the palpating finger a sensation of fluctuation and suggest a cyst or a softer encapsulated adenoma. The same is true of a certain type of medullary cancer.

Here, again, we have evidence of the difficulty of always distinguishing by palpation the benign from the malignant tumor. But if one will carefully record and try to memorize the sensations during the palpation of breast tumors, it is quickly found that the majority of encapsulated adenomas as well as blue-domed cysts are recognized by their mobility and their peculiar consistency and shape on palpation.

It is only in a relatively small number of cases that the palpation of the benign and malignant overlap.

*Palpation of Larger Encapsulated Adenomas.*—The moment a tumor reaches the size of a quadrant of the breast, or larger, and is still freely movable, and has the palpation of the encapsulated adenoma, one must think of sarcoma.

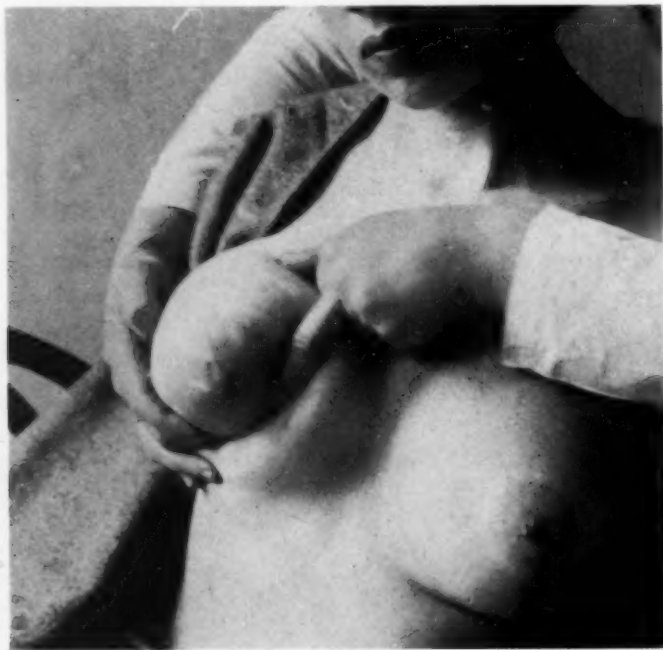


FIG. 7.—Pathol. No. 7135. Encapsulated aberrant fibroadenoma. Photograph of patient. The freely movable, large tumor is upwards and to the right; the breast to the medial and lower side. The patient was sixteen years of age. Operation: Excision of tumor only, breast preserved. It this patient had been over twenty-five, sarcoma in intracanalicular myxoma could not have been excluded. For gross appearance see Fig. 8.

There are two types of the larger encapsulated adenoma. One, more frequently situated outside the breast (aberrant adenoma) is of the fibroadenomatous type and has no tendency to sarcomatous change.

The larger encapsulated adenomas of the aberrant

adenoma type can be distinguished from the larger adenoma of the intracanalicular myxoma type only by the age of the patient and the situation of the tumor. The adenoma of the aberrant breast type is observed chiefly at puberty and in young women under twenty-five years of age; it is usually situated outside the breast. I have never observed sarcoma in the intracanalicular myxoma type at an age under twenty-five, or to be situated outside the breast.

Therefore, a large tumor which on palpation suggests encapsulation in a woman under twenty-five years of age is as yet without an exception a benign fibroadenoma and can be removed and the breast saved, but a similar

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large tumor in a woman over twenty-five years of age should be looked upon as suspicious of sarcoma, and either removed without exploration with the breast and major pectoral muscle or exposed for diagnosis.

In going over a large number of these cases one is impressed with how frequently in the past the breast of a young woman under twenty-five has been sacrificed for the benign aberrant adenoma because of the clinical diagnosis of sarcoma, and how frequently local recurrence has taken place after the removal by enucleation, or removal of the breast only for these larger encapsulated adenomas of the intracanalicular type in older women.

*The Differential Diagnosis Between Smaller Encapsulated Adenoma and Sarcoma.*—Now and then sarcoma may be a smaller tumor and palpate like an encapsulated adenoma. As I have reiterated in this paper, one should always bear in mind the possibility of malignancy, so that when one makes the incision for the removal of an apparently benign tumor of the breast the divided tissues should be carefully inspected as the incision is made down upon the tumor. Should one in dividing fat or breast find any evidence of *œdema* the tumor should be treated as malignant and in the majority of cases it will prove to be sarcoma. The cedematous condition is easy to recognize. If on removal and bisection of the tumor the *œdema* is observed outside the capsule or within the capsule, sarcoma should be considered, and a frozen section made.

*Sarcoma is never associated with fibroadenoma, only with intracanalicular myxoadenoma.* One, however, must be familiar with the usual very cellular stroma of the benign intracanalicular type. A few sarcoma of the breast arise independently.



FIG. 8.—Pathol. No. 21406. Photograph of encapsulated aberrant adenoma, removed by Doctor Royster of Raleigh, N. C. Note the distinct capsule in the lower left quadrant. The remainder of the tumor had been removed with a thin zone of breast tissue. Only the young age of the patient in this case allowed sarcoma to be excluded.

My experience teaches me that the *ædema* outside the tumor is almost positive of sarcoma, and one will quickly learn to recognize by inspection and from the frozen section the sarcoma in the smaller intracanalicular myxoma. As previously stated, every apparently encapsulated adenoma of the intracanalicular myxoma type which is larger than a quadrant of the breast, should be considered suspicious of sarcoma.

ENCAPSULATED ADENOMA MICROSCOPICALLY SUSPICIOUS OF CARCINOMA

*Cystic Adenoma.*—This is relatively infrequent. I have studied about 22 cases. The majority have been received in the laboratory from outside

sources with this history: The surgeon has palpated what he considered a benign encapsulated tumor; in removing the tumor he found it to be distinctly encapsulated and containing a number of minute cysts; either at the time of operation from a frozen section, or later, the pathological report has been "adenocarcinoma" or "suspicious of malignancy." The surgeon has been in a dilemma, and instead of performing the complete excision of the breast or the complete operation for cancer,

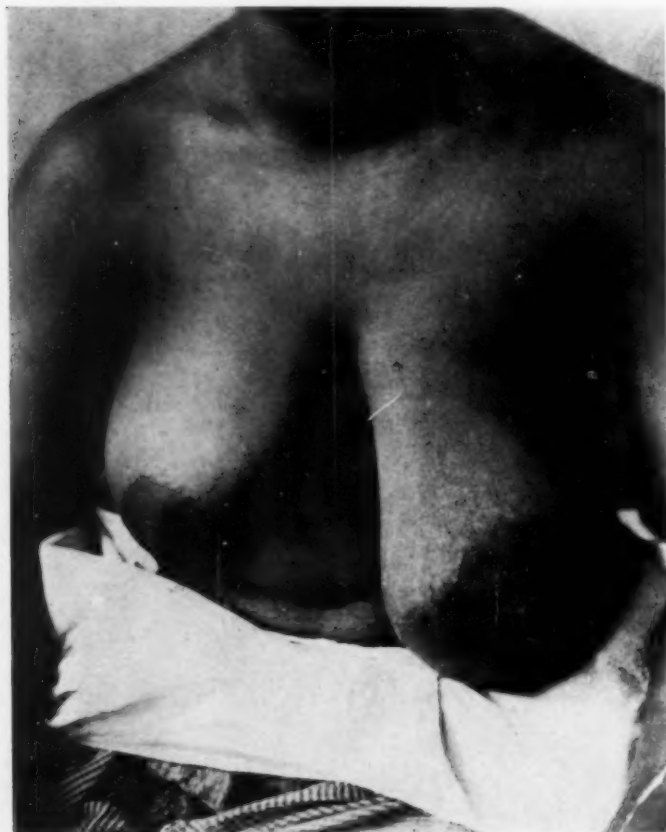


FIG. 9.—Pathol. No. 7105. Unilateral hypertrophy of left breast, in a girl aged sixteen. Large palpable tumor in inner hemisphere. Unnecessary complete removal of breast on diagnosis of sarcoma. For gross see Fig. 10.

he has submitted the section to other pathologists. In all of these cases there has been a divided opinion. In none has the operation been more than the removal of the tumor. I have followed every patient, some more than ten years—there is yet to be a recurrence, or any evidence of local or general malignancy.

This is still happening with about the same frequency. The gross and

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FIG. 10.—Pathol. No. 7105. Encapsulated aberrant fibroadenoma to right. Nipple, areola and breast to left. The large tumor to the right could have been removed and the breast saved. The age of the patient excludes sarcoma.



FIG. 11.—Pathol. No. 1085. Gross section through large tumor of the breast in woman over thirty years of age. Chiefly an encapsulated cystic and solid intracanalicular myxoadenoma, with sarcomatous areas. Enucleation of tumor only. Local recurrence in pectoral muscle. Death due to infiltration of chest wall and lung. The only distinguishing feature of this patient in Fig. 11 from the patients in Figs. 7 and 9 is the age. If the large tumors are explored, the aberrant fibroadenoma (Fig. 10) is easily distinguished from the intracanalicular myxoma (Fig. 11). Malignancy (sarcoma) has never been observed in the fibroadenoma no matter what its size, while sarcoma is the rule in large intracanalicular myxoadenomas.



microscopic appearances of these encapsulated cystic adenomas microscopically suspicious of carcinoma are identical with 18 cases of non-encapsulated cystic adenoma, which I have reported in the *Archives of Surgery* for November, 1921, vol. iii, pp. 446 and 513. They are classed under BB-13-7. The chief difference was that the majority of the non-encapsulated cystic adenomas microscopically suspicious of malignancy were subjected to the complete operation for cancer. These patients have also been followed and without evidence of local or general metastasis up to date.



FIG. 12.—Pathol. No. 29383. Small, almost encapsulated sarcoma in intracanalicular myxoma. This tumor palpated like a benign tumor. At the exploration oedema was encountered, and the nicked tumor was juicy like a sarcoma. For this reason the complete operation for cancer was done. The right photograph shows the tumor to right and the cauterized fat of the exploratory wound and the skin to left. The partial obliteration of the capsule is quite distinct in the right photograph. The left photograph shows a tumor almost encapsulated. Compare with Fig. 3-b. The oedema outside the tumor and the juiciness of the tumor does not show. For microscopic pictures see Figs. 13 and 14.

The practical question is what to do. My experience teaches me that if the tumor is distinctly encapsulated, treat it as a benign tumor, unless it is an intracanalicular myxoma with microscopic appearance of sarcoma. Then treat it as a sarcoma. If the explored tumor is not encapsulated, treat it as a malignant tumor unless you are positive from the frozen section that it is benign. This is a safe working rule. It means that you will never do an incomplete operation for cancer, but now and then you will do a complete operation for a benign lesion.

*Fibroadenoma.*—Much less frequently have the encapsulated fibroadenomas shown microscopic areas suspicious of cancer. But in one group

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areas suspicious of cancer are quite frequent—almost constant, and that is in the *calcified old fibroadenomas*. Here in zones of fibrous tissue we find nests of epithelial cells, remains of the old parenchyma, duct and acini arrangement is lost, basement membrane is not to be seen. You know it cannot be cancer, at least in a biological sense. These calcified tumors have been present for years and have remained quiescent. It is very important to remember this histological picture, because one now and then meets it in encapsulated fibroadenomas that are not calcified and in non-encapsulated tumors of the breast.

*Intracanalicular Myxoadenoma.*—Very infrequently have such tumors been referred to the laboratory as suspicious of carcinoma, but every now and then, as mentioned before, the very cellular stroma of the benign encapsulated tumor has been looked upon as sarcoma.



FIG. 13.—Pathol. No. 29383. Photomicrograph (low power) of intracanalicular myxoadenoma with cellular areas of sarcoma. For gross appearance see Fig. 12. For high power see Fig. 14.

### THE ULTIMATE RESULTS IN PATIENTS OPERATED ON FOR ENCAPSULATED ADENOMA WITHOUT REMOVAL OF THE BREAST

It is now more than thirty years since the first operation of this kind in Halsted's clinic, and there is a record of almost 400 cases. In a large number the age of the patient at the time of operation has been over twenty-five years. Remarkable is the observation that up to date, none of them have returned with cancer of the breast. A small per cent. have returned with a tumor in the operated breast, or in the other breast, and these tumors when explored have proved to be encapsulated adenomas. It seems strange that in such a large number of women, many of whom were at the cancer age at the time of operation, not one has returned with cancer of the breast. Another remarkable observation is that we rarely find encapsulated adenoma and cancer in the same breast. Billroth pictures an example of multiple encapsulated adenomas and cancer in the same breast. I have two such

examples, in which there was no evidence that the cancer developed in the adenoma but in the breast between.

When we come to carcinoma, the same is true—practically all patients operated upon for cancer of one breast, when they return with a tumor in the other breast, this tumor with the rarest exceptions is also cancer. The simultaneous development of cancer in both breasts is very, very infrequent, but this is not so as regards adenoma.

How shall we explain cancer in tumors of five, ten, fifteen and twenty years' duration? In the first place, it is very rare. Many of them are areas

of chronic lactation mastitis leaving a residual scar tumor which has never disappeared. My observations prove this possibility, but as yet I have been unable to positively prove the development of carcinoma in preëxisting adenoma. The removal therefore, of a distinctly encapsulated small quiescent adenoma is not based upon the theory that its removal will protect the patient from future cancer.

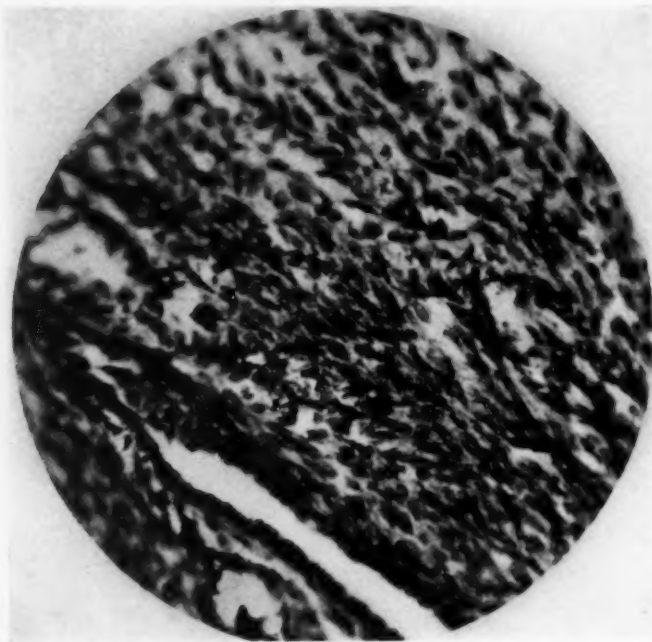


FIG. 14.—Pathol. No. 29383. High power photomicrograph. Sarcoma in intracanalicular myxoma. For low power see Fig. 13, for gross see Fig. 12.

cer. The object of such an operation is based upon the evidence that in the early stage cancer and adenoma cannot be differentiated. One operates because of the possibility of cancer and to give the patient the benefit of the earlier radical removal. If the tumor proves to be benign there is no difficulty in removing it without injury to the breast.

*Adenoma in Pregnancy and Lactation.*—Most of the encapsulated adenomas removed from the breast during pregnancy or lactation, which have been received in the laboratory from outside sources, came with the clinical diagnosis by the operator of a benign encapsulated tumor, and the microscopic diagnosis of "adenocarcinoma" or "suspicious of malignancy." Years ago, Billroth observed that adenoma of the breast like aberrant breast underwent the same histological changes as the breast during pregnancy and

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lactation, even to the secretion of milk, and if the pathologist is not familiar with the microscopic picture of lactation hypertrophy, the mistake of calling such an adenoma "adenocarcinoma" will be frequently made.

A good reason for removing benign tumors in women under twenty-five and under twenty is that during a later pregnancy and lactation the tumor may enlarge with the breast, give pain, and more frequently great anxiety, and may make an operation necessary at a more inconvenient time. They also run a greater risk of a complete operation for cancer based upon an incorrect pathological diagnosis.

### *Operations Upon the Breast During Pregnancy and Lactation.*—

My records show that the removal of a benign tumor from the breast during pregnancy or lactation is devoid of complications on the part of the mother, her breast or the child. I am inclined to feel, however, that it requires greater skill. The breast in pregnancy is very vascular, and greater care must be exercised in controlling hemorrhage

and the closure of the wound. Otherwise there will be hæmatoma, infection and mastitis. In operations during lactation one must expect a discharge of milk from the wound for a few days. It is my rule to have the child nurse and empty both breasts. Then immediately remove the tumor under local anæsthesia, if possible, and the child can nurse again at the regular time.



FIG. 15.—Pathol. No. 13599. Encapsulated cystic adenoma diagnosed microscopically by many pathologists as suspicious of cancer or adenocarcinoma. Patient aged twenty-two. Capsule as distinct as in Fig. 3-a. Tumor and zone of breast only removed. No recurrence after eight years.



*Exploratory Incision and Excision of Benign Tumors of the Breast.*—As repeatedly emphasized in this article, the object of the operation, if the patient is over twenty-five, is not so much to find and remove a benign tumor, as to recognize quickly the possible malignant tumor and then to cauterize the wound chemically or thermally and to perform at once the complete operation for cancer.

One only has to explore a few lumps in the breast to realize why the majority of surgeons prefer to remove the breast. This

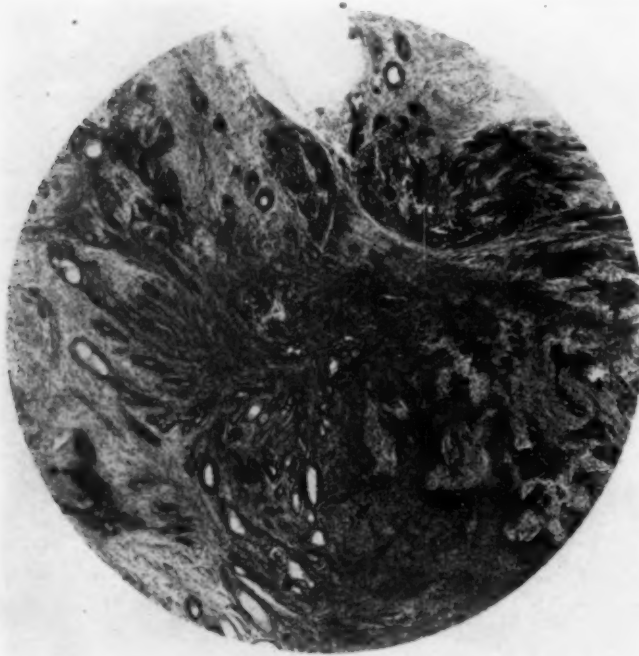


FIG. 16.—Pathol. No. 26574. Section (low power) from a small, distinctly encapsulated fibroadenoma, which might be interpreted as suspicious of malignancy. No recurrence after excision of the tumor only.

is due to the difficulty of recognizing the benign from the malignant by the gross appearances, and even in the immediate frozen section. There is always the fear of cancer, the fear of overlooking cancer. Recently I have learned from some of my most experienced colleagues that they dislike to remove a lump from the breast, because they had difficulty with the healing of the wound after closure.

In my first ten years of experience in the diagnosis and surgery of breast tumors, my records show that if Doctor Halsted and his associates had performed the complete operation for cancer of the breast upon every woman who presented herself to the clinic, it would have been unnecessary in about twenty-five per cent. of the cases. But during those ten years there was a sufficient number of benign tumors and doubtful tumors, to lead Doctor Halsted to develop his method of exploratory incision, recognition by the gross appearance only, and chemical disinfection, if the tumor proved to be malignant. During these ten years in only two instances was an incomplete operation for cancer performed, and in about ten per cent. of the cases benign tumors were incorrectly diagnosed malignant clinically, or in the gross, or in the microscopic section.



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Since 1920, in many clinics, due to the education of the public, there has almost been a reversal in the relative frequency of benign and malignant lesions. In my own clinic it is now running about seventy-five per cent. benign and twenty-five per cent. malignant. It is important to note that of the seventy-five per cent. benign two-thirds are not subjected to operation.

Exploratory incision, therefore, is becoming more and more frequent and necessarily so.

From a diagnostic standpoint the explored tumor may be divided into three groups, the distinctly benign, to which belong the encapsulated adenoma, the blue-domed cyst of chronic cystic mastitis and a few distinctly benign intracystic papillomas and practically all single galactoceles. To the second group belongs the distinct carcinoma, chiefly scirrhous and medullary, and most of the cancer cysts which are very rare. I also feel that the majority of surgeons should easily recognize colloid cancer as a non-

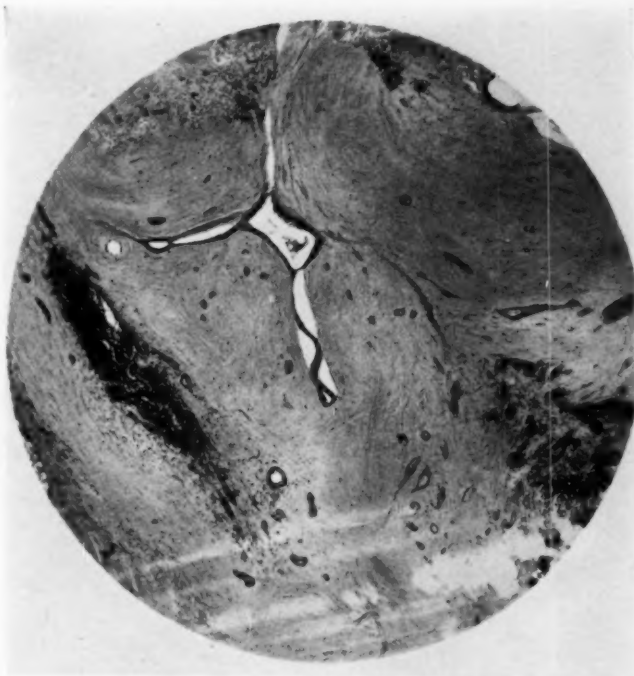


FIG. 17.—Pathol. No. 26517. Low power photomicrograph of typical fibrous, old intracanalicular myxoma. Tumor the size of a bean. The cellular area (see Fig. 18) is suspicious of malignancy.

encapsulated circumscribed tumor which looks somewhat like colloid thyroid adenoma, and from which often gelatinous material can be expressed, and the non-encapsulated, circumscribed comedo, or duct cancer, from which worm-like masses of comedoes can be expressed on pressure.

These two great groups—the distinctly benign and the distinctly malignant—should be easily recognized in the gross, and the cancer cases are just as distinct in the frozen section. It is, important to recollect, as already brought out, that immediate and even permanent sections of the distinctly benign and encapsulated adenomas may reveal microscopic pictures suspicious of cancer. The same is true of the breast-tissue wall of a blue-domed cyst.

The third group is composed of non-encapsulated areas of breast tissue

which differ somewhat from the surrounding breast or of more definite tumor areas which differ from the encapsulated adenomas in the absence of a capsule and the inability to enucleate them or shell them out. To this group also belong some doubtful cysts, some with and some without intracystic papillomas. The areas, whatever their nature, are never encapsulated, although they may be circumscribed, and there may also be diffuse infiltration of the breast.

At the operation of exploration, I gather from the evidence, the fear

of cancer has more to do with their apparent resemblance to cancer than the real appearance of the tissues themselves.

When these cases are studied in cold blood after operation, their benign nature is usually thoroughly understood.

This group, however, even to the most experienced, presents difficulties, and there must be a working rule, that is, when in doubt perform the complete operation for cancer.

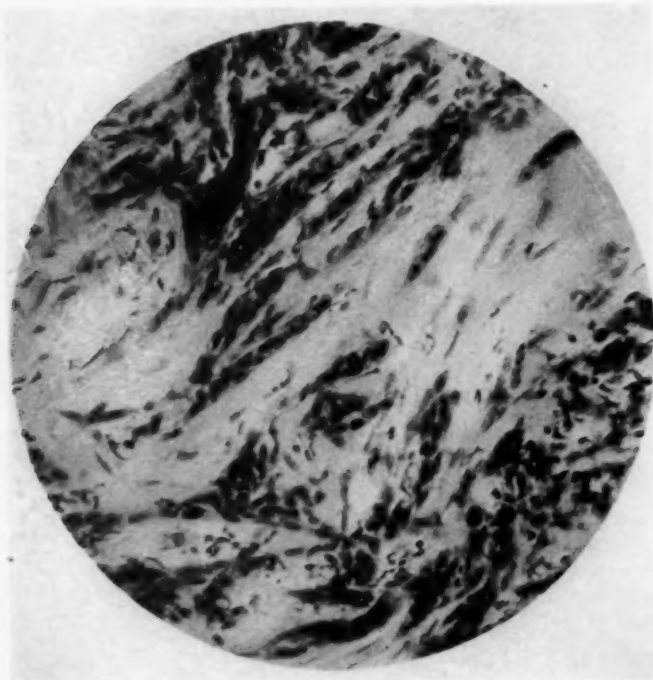


FIG. 18.—Pathol. No 26517. High power photomicrograph of cellular area shown in Fig. 17. Suspicious of malignancy. Such areas are frequently seen in the very fibrous parts or calcified parts of old adenomas of all types, whether encapsulated or not. In this case the tumor only was removed and there is no recurrence.

I have evidence to show that in many clinics throughout this country, this group is being correctly recognized as a benign lesion by many operators from the gross appearance at the exploratory incision and by many surgical pathologists from the frozen section.

It is very important to record here that many of the cases in this third group are pathological processes which tend to spontaneous recovery, or to assume, in the later stages, a gross and microscopic picture typical of benignancy. For example, tubercular mastitis before the stage of abscess and caseation closely resembles infiltrating scirrhus; in the stage of abscess and sinus it presents no difficulties.

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In the early years of the past quarter of a century, the patients of this third group either did not appear in the clinic at all, because the mass in the breast disappeared, or, if they did, it was so late that a correct diagnosis could be made clinically. Surgeons and pathologists saw these cases only at rare intervals, there was no organization or method for exchange of views or material. Now the opposite is true, and this third group is increasing in numbers, and in the past two years this pathological lesion is often

received in the laboratory after its local removal only and with the correct diagnosis. Nevertheless, the majority of surgeons must first attempt to be conservative and remove the tumor only in the encapsulated adenoma and the blue-domed cyst, the galactocoele, and the distinctly benign intracystic papilloma. Subject all others to the complete operation for cancer. Then study and restudy in the laboratory the clinical history, the

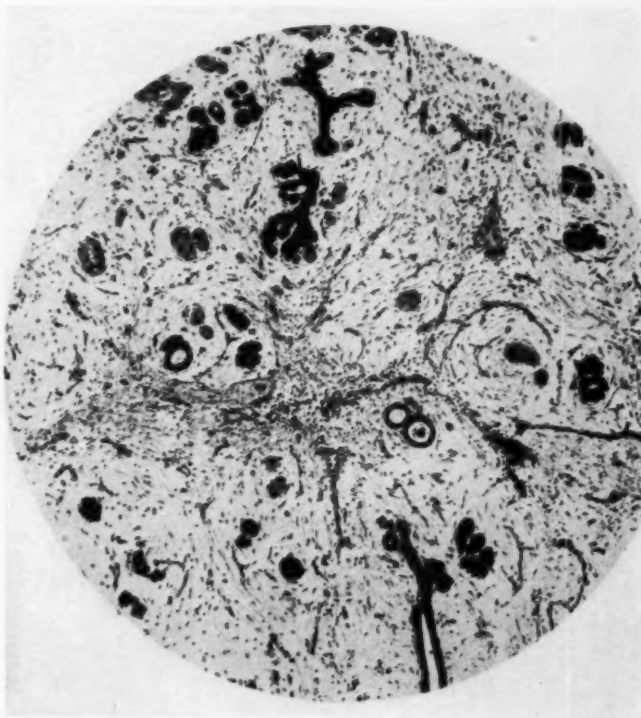


FIG. 19.—Pathol. No. 21175.—The usual microscopic appearance of intracanalicular myxoma.

gross specimen and the permanent sections of the third group, and prepare yourself to recognize this group more frequently at operation.

*First Method of Exploratory Incision.*—This is the method that Doctor Halsted employed, during the nine years of my association with him in the clinic at Johns Hopkins Hospital, and my later experience of twenty-three years, still finds it the method of choice, the one to be used in all suitable cases, which up to the present time represents the majority.

The method consists of cutting down upon the single definite palpable mass which has no definite signs of malignancy. The object of the incision is to ascertain the nature of the lump with the least possible exposure of uninvolved tissue and with the smallest wound possible, so that if cancer is found there can be an immediate chemical or thermal cauterization of the wound.

Palpable tumors have three definite positions: One, tumor tissue is at the surface of the breast, so that one cuts through skin and subcutaneous fat only. Two, the tumor is imbedded in breast tissue and one must cut through breast tissue before the tumor is seen. Three, the tumor is between the breast and the pectoral fascia. This is a very rare position, and in my experience only benign tumors—encapsulated adenoma and the blue-domed cysts are found in this locality. I have had now, more than thirty years' experience in making this form of exploratory incision.

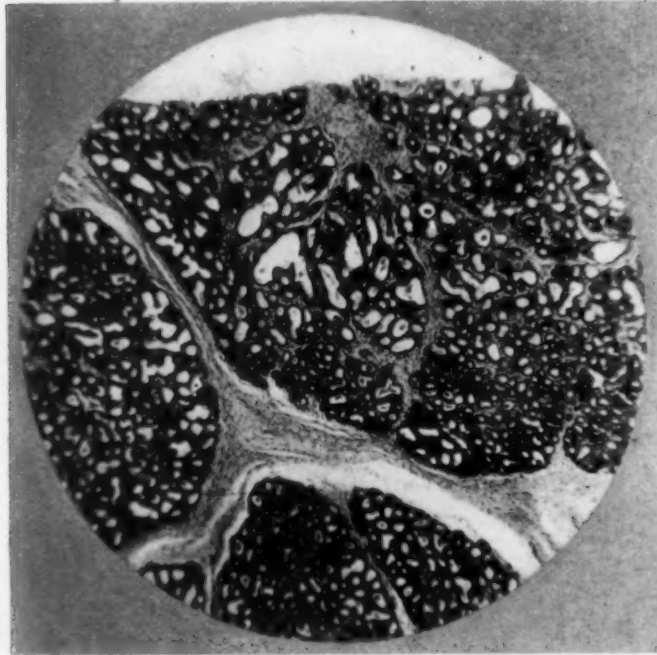


FIG. 20.—Pathol. No. 26493. Lactation hypertrophy in an encapsulated adenoma removed during lactation.

In every case in which I assisted Doctor Halsted or Doctor Finney in the early years and in every case in which I was the operator, I have on record in the laboratory a written note of what was seen and felt at this exploratory incision.

*Subcutaneous Tumors*—When the breast tumor occupies the surface of the breast it has no covering but the subcutaneous fat. When a scirrhus carcinoma has reached

this point there is usually dimpling of the skin or evidence of atrophy of the subcutaneous fat or adherent skin, but when the tumor is a circumscribed scirrhus or a medullary carcinoma, or a cancer cyst, or a small sarcoma, it may palpate like a benign tumor and not be associated with changes in the skin or subcutaneous fat.

My recorded experiences and my memory of them emphasize one very important easily demonstrable feature. In cutting through the skin and subcutaneous fat down upon the palpable tumor and moving the knife from side to side, the benign tumor is exposed at once, readily, because the tissue is easily moved from the capsule of a benign cyst or encapsulated adenoma, while the tissue is more fixed to the malignant cyst or to the circumscribed or infiltrating area of cancer, and, as mentioned before, usually outside the more circumscribed sarcoma there is oedema. When the exploration is made



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slowly, one, so to speak, feels that the tumor is malignant before it is seen. If it is benign, a blue or gray dome of a cyst comes into view, or the distinct brownish-gray capsule of an adenoma. When one nicks the benign cyst the material is clear or cloudy; the galactocele contains milk; the cancer cyst has thick, grumous material. If the cyst contains blood it should be treated as malignant unless one can quickly demonstrate a distinctly benign intracystic papilloma. The contents of the cyst, therefore, is characteristic of the benign and of the malignant cyst.

The most characteristic feature about the benign encapsulated adenoma when it is exposed beneath the subcutaneous fat, is its distinct capsule, the fact that it can be shelled out, that in separating it from the surrounding tissue one can see fine cobweb connective-tissue between the capsule and the surrounding fat or breast. I have never observed this in the malignant tumor. In a few instances I have observed oedema about an encapsulated adenoma, but in all



FIG. 21.—Pathol. No. 15518. Lactation hypertrophy suspicious of malignancy in an encapsulated adenoma removed at the end of lactation.

of these cases there had been recent trauma, otherwise oedema has been associated with malignancy. It is therefore easier to distinguish the benign encapsulated adenoma from its surroundings, its enucleability and its capsule. When the tumor is cut into, it cannot be so readily distinguished from a sarcoma of the fibrosarcoma type, nor from a circumscribed scirrhus. Some small medullary carcinomas closely resemble the small intracanalicular myxoma.

The cancer cyst, whether arising in a papilloma or not, may have a blue dome. Its wall may resemble that of the benign cyst, but it is never as readily separated from the surrounding tissue, the cobweb tissue is usually absent, there is frequently oedema. (The blue dome over a cancer cyst has been seen only once in ten cases.) Fortunately, as stated before, the differ-



ential diagnosis is quickly made when we nick the cyst and examine its contents.

I am beginning to feel that as our experience grows, we will be able to recognize the malignant cyst without cutting into it.

When the tumor is buried in the breast tissue, one cannot recognize the benign from the malignant by the surface of the breast, exposed after



FIG. 22.—Pathol. No. 14430. The correct appearance of the breast after the excision of a benign tumor. The position and radiation of the incision varies. In this case the tumor was aberrant in the periphery towards the axilla. Note the symmetry of the breast is preserved.

dividing the subcutaneous fat, nor is there anything characteristic in the breast tissue itself when it is divided, until one comes to the immediate surroundings of the tumor. Then what I have just described again holds true.

*Second Method of Exploratory Incision.*—When the palpable tumor is very small, or the breast is large, fatty, I have found it more convenient to excise the palpable area with a good margin of surrounding breast and, after removal to place an alcohol sponge into the wound.

Then take the tumor, place it on a towel, hold it in the left hand, and with the knife in the right hand explore and bisect the tumor. This makes the differential diagnosis easier, it is better for a rapid frozen section, but I rarely employ it, except for the above indications. Perhaps for these surgeons whose experience is still limited, this might be the better method to employ.

*Third Method of Exploratory Incision.*—The idea comes from Warren, of Boston, who made a circular incision around the periphery of the breast, turned the breast up and explored the palpable lump or lumps from the

## BENIGN TUMORS OF THE BREAST

posterior surface. I have known of this method since its introduction and publication, employed it on a few occasions many years ago, but abandoned it and found it a few days ago very satisfactory in a very difficult case.

The patient was a young woman about twenty-eight years of age, unmarried; both breasts were large and of the diffuse virginal hypertrophy type. That is, their size was due to parenchyma and not fat. Both nipples were congenitally retracted. There was a definite palpable mass in the midzone of

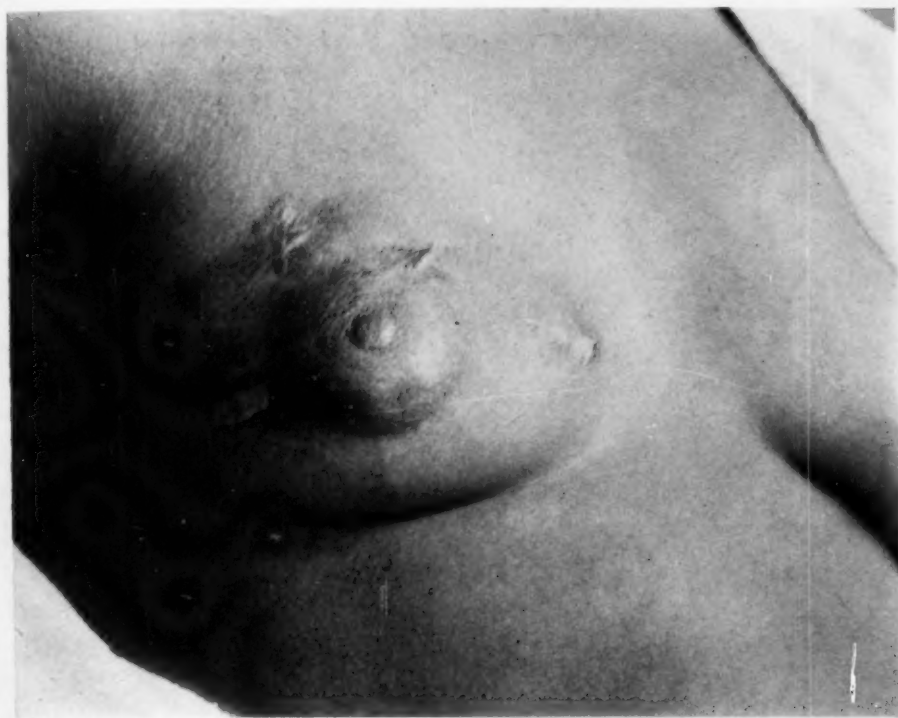


FIG. 23—Pathol. No. 21193.—Wound complication after excision of a benign breast tumor. Note that the symmetry of the breast is preserved. In this case a hæmatoma formed, became infected, and three incisions were necessary for drainage. But the breast was saved. Note the four skin scars.

the lower hemisphere. It did not have the movability of a benign tumor, was an irregular mass of indurated breast tissue of a type which I have described as mastitis. This palpable type is more frequently malignant than benign, except during lactation. The mass seemed buried in the breast tissue. When we moved the mass the congenitally depressed nipple pulled in further. All of us in the clinic concluded that it was malignant. In view of its situation deep in the hypertrophied breast, I decided upon the second method of exploration, but when the breast parenchyma was exposed I found it could be easily separated from the fat, and it occurred to me to follow Warren's method and look and feel at the involved area from the posterior surface. On doing so, palpation suggested a cyst. I then resected the

involved area, cutting through normal breast tissue, and then, on bisection, revealed a gray-domed, thick-walled benign cyst, and excluded malignancy.

**Plastic Closure.**—The method still employed is the one taught me by Halsted in 1893, and during these thirty years it has been employed with success with increasing frequency. One change has been made after the first three cases. Silk is never employed, either for ligature or suture, in the plastic closure.

In removing the tumor, plan the excision as nearly as possible to a wedge-



FIG. 24.—Photograph of patient showing the proper result after the excision of a benign tumor in the right breast and a faulty result in the left breast. The latter is due to failure to suture the breast defect—a definite plastic procedure (see text page 24).

shaped piece with the apex towards the areola or nipple. The skin incision should radiate from the areola. It is better to excise down to the pectoral fascia, except in very small tumors in large breasts. Every bleeding point should be ligated. The defect is closed with chromic catgut suture of 00 size; heavy catgut is not necessary. According to the thickness of the breast the sutures are in two, three or four layers. The first layer is posterior from nipple zone to periphery and the other layers follow, approximating the defect from the nipple outwards and from within outwards. The subcutaneous fat is approximated with catgut, and the skin is closed with interrupted fine silk passed with straight intestinal needles. If there is any puckering, remove the stitches and resuture. Even with a large defect, an

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irregular defect, this plastic suture is possible and the symmetry of the breast is restored to normal. The reduction in size of the breast varies with the amount of breast tissue removed. A perfect and an imperfect plastic operation are shown in Fig. 24 on the two breasts of the same patient.

The only complication has been a hæmatoma. In two of my cases which I dressed myself, the wounds healed by granulation, and the cosmetic result was as good as in wounds healing per primam. In a third the hæmatoma became infected, and multiple incisions were necessary to save the breast (Fig. 23). In one case the patient unfortunately was discharged with an unrecognized hæmatoma which became infected, and the breast was removed elsewhere. There are about 400 operations of this kind with these few hæmatomas, two definite infections and the loss of one breast.

Therefore, hæmostasis is essential. The next is the proper fixation of the breast with padding and bandage, important in all cases and essential in large pendulous breasts. It is our rule to redress daily in order to evacuate any serum

by pressure, or immediately to recognize any hæmatoma and evacuate it.

The skin stitches are never removed until the fourth day, and then every alternate stitch only. All stitches are out on the sixth or seventh day. When tumor, incision and the breast are small, the patient often leaves the hospital the day after the operation. The larger the wound and the breast the longer the patient is kept quietly in the hospital, up to the seventh or tenth day.

The object of this operation, if the tumor is benign, is to save the patient from the mutilation of a disfigured or removed breast. Therefore, every care is essential in the plastic closure and in the subsequent proper dressing of the wound and fixation of the parts.



FIG. 25.—Pathol. No. 9808. Definitely encapsulated fibroadenoma buried in breast tissue. Removal of breast unnecessary.

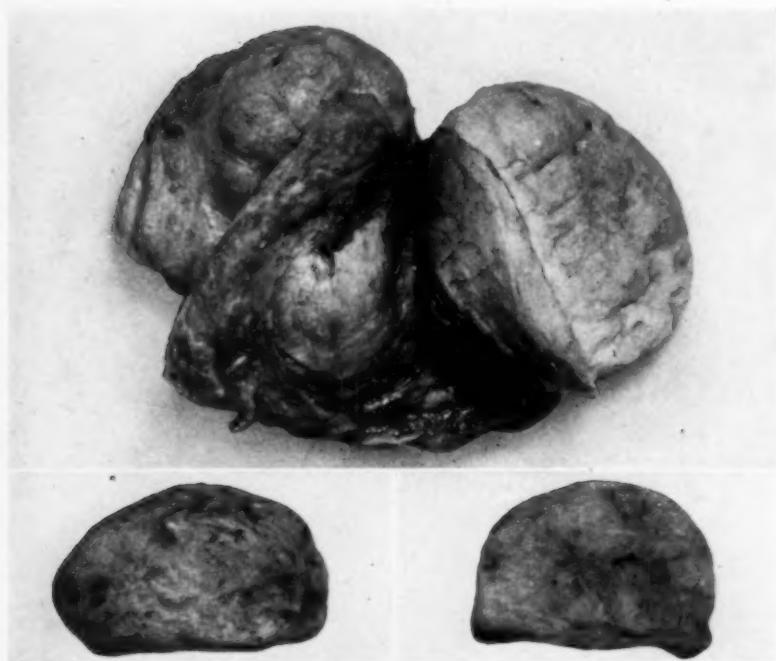


FIG. 26.—Pathol. No. 702. Encapsulated intracanalicular myxoadenoma. To the right notice the capsule being peeled from the tumor. To the left the surface of the capsule and the cut surface of the tumor.

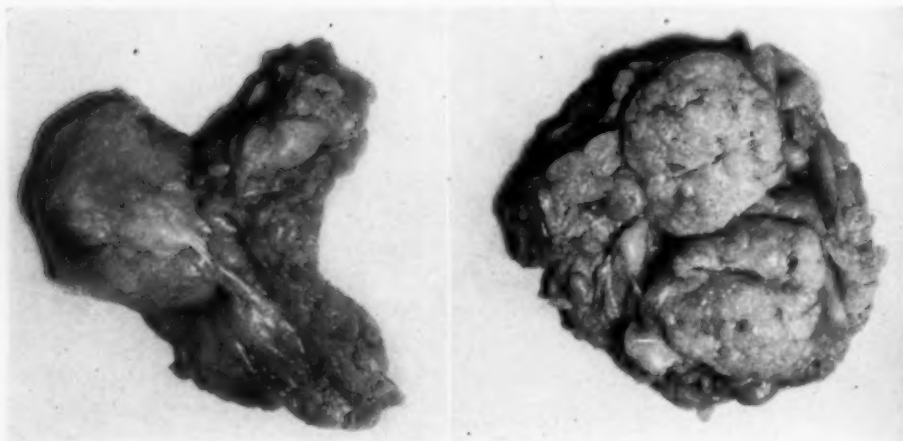


FIG. 27.—a. and b. Pathol. No. 31194. Encapsulated intracanalicular myxoadenoma, removed with zone of breast. The tumor is shown bisected with the surrounding breast. b. Pathol. No. 31194. Encapsulated adenoma. Tumor with capsule above; breast tissue below. The white lines represent the cob-web connective-tissue between the capsule of the benign tumor and the breast. I have never seen this in malignancy. It may also be obliterated by the inflammatory reaction of trauma (see Fig. 5).



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*Conclusions.*—A colleague and a pathologist has just written me: "Why remove benign encapsulated adenomas?" They are only isolated areas of normal breast tissue and as such have no more tendency to become malignant than the breast left behind after their removal." I trust this paper will answer his question. I have tried to emphasize that the object of exploration is not to remove a benign tumor, but to expose and recognize a possible malignant tumor in the most favorable stage for a cure by the radical operation. Having exposed a benign tumor, it requires very little more time to completely remove it, because the differential diagnosis often goes to a point where the benign tumor must be partially removed and in some cases completely removed before the differentiation from cancer is possible and made certain.

There is a second reason for the removal of a benign encapsulated adenoma. The evidence is that sarcoma usually develops in the intracanalicular myxoma type of adenoma. It is quite possible that the malignant tumor giving a long history may have developed in preëxisting adenoma.

## **SOME OBSERVATIONS ON THE TREATMENT OF FRACTURE OF THE SKULL \***

**REPORT OF ONE HUNDRED CASES FROM THE PENNSYLVANIA HOSPITAL**

**BY HENRY P. BROWN, JR., M.D.**

**AND**

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**OF PHILADELPHIA, PA.**

THERE have been several articles in the recent literature on fracture of the skull, the observations usually being from the service of one man, and treated by him or under his direction.

The object of this paper is to present the results obtained from the treatment of such cases, in a general hospital, by numerous surgeons, where no special research has been done on the subject. We fully realize that the best results are usually obtained under the intensive study plan in which all cases of a certain type are grouped under one man's direction, and where a comparison of technic, as shown by the improvement, if any, in the end results, can be noted with more accuracy.

On the other hand, there are advantages in having more than one man's ideas in the management of cases, and such a method would possibly give a more accurate representation of what one may expect in the general treatment of such a class.

For purposes of study, 100 fractures of the skull were taken in the order in which they were admitted to the Pennsylvania Hospital. We fully realize that this number is far too small to warrant drawing any conclusions of value, and yet it may give a fair idea of the results to be expected in the ordinary run of fractured skulls as they are admitted to a general hospital.

We are indebted to Doctors Harte, LeConte, Gibbon, Hutchinson, Stewart and Mitchell, upon whose services they were admitted, for the privilege of reporting them. The X-ray examinations were made by Dr. David R. Bowen, and one of us (Doctor Strecker) made a neurological examination of such patients, as we were able to follow after leaving the hospital, these observations being recorded elsewhere in this paper.

It is unfortunate that we were not able to trace more of our patients, but lack of sufficient personnel in the Social Service Department made such a task impossible. We are indebted to this department for all of the replies that were received.

Needless to say, a diagnosis of fracture of the skull is often a difficult one to make, and it is not the intention of this paper to enter into the question of differential diagnosis. Only such cases were included in this study as

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\* Read before the Philadelphia Academy of Surgery, November 5, 1923.

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were definitely diagnosed as fractures by the Surgical Chief in charge, and yet to make the observations still more accurate, even this list has been further subdivided into "positive" and "doubtful." The latter class include those in which the clinical notes made by the resident are insufficient—unfortunately so in some of the most interesting cases—or where for one reason or another in reviewing the histories there seems to be a possible question as to diagnosis. Bearing this differentiation in mind, they are all included under the general heading of fractured skull.

Cases that were moribund on admission, dying within a few hours, are not included in this paper. Forty-eight of this type, crushed, gunshot, etc., were admitted during the period over which our observations extended. In a few instances the patients were sent from the receiving to the surgical wards, only to die within twenty-four hours. These are included in our list, as it was thought they had a possible chance of recovery.

Unfortunately the results of spinal puncture and blood-pressure were not recorded in the histories with sufficient regularity to be included in the general observations. There is no question that had they been so mentioned, it would have made this study more complete, but we do not think, however, that even had they been included, they would have materially altered the end results.

TABLE I.  
*Location of Fracture and Age of Patient.*

Age	Base		Vault		Base and Vault
	Positive	Doubt.	Positive	Doubt.	Positive
1-10	1	2	16	0	2
11-20	3	1	10	0	0
21-30	4	1	12	0	3
31-40	8	4	3	0	2
41-50	12	0	7	1	1
51-60	1	2	0	0	1
61-on	1	0	1	0	1
	30	10	49	1	10

The difficulty of making a diagnosis has been mentioned. In this series it was checked up either clinically by the X-ray or both.

A comparison of the age of the patient and the location of the fracture, as seen by Table I, shows that the largest group was fracture of the vault in children under ten years of age, 16 cases. Then followed the vault between twenty and thirty years and the base from forty to fifty years, each with 12 cases. Only one "positive" and two "doubtful" fractures of the base were recorded under ten years of age.

It was of interest to see how often the X-ray substantiated the clinical diagnosis, how many times it failed to do so and the occasions upon which the patient did not show clinical evidence of fracture, and yet it was revealed by the X-ray.

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Table II shows that when clinical signs of fracture of the base were present, the X-ray was negative or doubtful thirteen times and positive twelve. When clinical signs of basal fracture were absent or doubtful, the X-ray was negative twice and positive twice. The X-ray detected every fracture of the vault that gave positive clinical evidence and was positive in the four fractures of the vault that were clinically doubtful. In some cases for various reasons a picture was not taken.

On admission fifty-two of the patients were unconscious, stuporous or irritable, with or without bleeding from eye, ear, pharynx or mastoid; ten

TABLE II.  
*Correlation of X-ray and Clinical Diagnosis.*

Clinical evidence of fractured base present	{ X-ray negative or doubtful..... 13 X-ray positive..... 12
Clinical evidence of fractured base absent or doubtful	{ X-ray negative or doubtful.... 2 X-ray positive..... 2
Clinical evidence of fractured vault present	{ X-ray negative or doubtful..... 0 X-ray positive..... 34
Clinical evidence of fractured vault absent or doubtful	{ X-ray negative..... 0 X-ray positive..... 4
Clinical evidence of fractured base and vault present	{ X-ray negative..... 1 X-ray positive..... 10

showed paralysis in addition to the foregoing. In two there were no symptoms recorded and yet the X-ray showed a fracture. Eighteen were conscious and five were conscious, and in addition were paralyzed or bleeding, or both. Of the doubtful cases ten were in the first group—unconscious, stuporous or irritable—one showed paralysis in addition; one was conscious and paralyzed or bleeding and one was delirious.

A comparison of the type and location of the fracture in reference to mortality, with or without operation, as shown in Table III, shows that of the "positive" cases, four with a fissured fracture of the vault were operated upon and recovered and one died; of those not operated upon thirty-two recovered and one died. It is possible that some belonging to this group may have had a fracture of the base in addition, but if so, it was not recorded.

Of the depressed fractures of the vault, ten were operated upon, six recovered and four died, while in the non-operated group, five recovered and one died. It is needless to say that in this latter group the depression was not very marked.

The only certain case of fracture of the base that was operated upon died, as will be mentioned later. Of the "positive" cases of the base that were not operated upon, twenty-one recovered and eight died; of the "doubtful," not operated upon, three recovered and five died. There were ten cases of base and vault not operated upon, classed as base, of which number, seven

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lived and three died. One "doubtful" depressed fracture of the vault recovered with operation.

A summary of this list, Table III, shows that of all the cases operated upon, eleven recovered and six died, an operative mortality of 35.2 per cent. Of those that did not receive operation, sixty-three lived and twenty died, a mortality of 24.4 per cent. In comparing these figures it must of course

TABLE III.

*Location and Type of Fracture—Operated or Not Operated Upon—Recovered or Died.*

		Operated upon		Not operated upon	
		Recovered	Died	Recovered	Died
"Positive"	Fissure { Vault.....	4	1	27	1
	Base.....	0	1	21	8
	Depressed Vault.....	6	4	5	1
"Doubtful"	Fissure { Vault.....	0	0	0	1
	Base.....	0	0	3	5
	Depressed Vault.....	1	0	0	1
Vault and Base.....				7	3
		11	6	63	20

be borne in mind that the cases operated upon were in a much more serious condition than the others.

One of the most difficult questions for us to decide in fracture of the base is: When should operation be done? A comparison of the results of operative and non-operative treatment as published by different men, varies widely. Even the most ardent supporters of the former would obviously not operate in every case of fracture of the base. Accordingly each case must be judged on its own merits, and what would be considered by one man as clear indications for surgical interference may not be so regarded by another equally competent observer. Hence the statement, "When in doubt, don't operate," is interpreted differently by various men.

From the fact that only once in this series was operation done specifically for fracture of the base, and this case died on the table, it is needless to say that at the Pennsylvania Hospital the conservative treatment has prevailed.

The mortality for decompression to relieve symptoms resulting from fracture of the base varies with different authors, averaging from 70 to 85 per cent. There is no doubt that several of our cases presenting serious symptoms have recovered without operation, and on the other hand, a goodly proportion of them died (34.0 per cent. of the non-operative cases).

This may be rather a high mortality for non-operated cases of fracture of the base, and yet we feel that undoubtedly by conservative treatment we have saved cases which more radical surgeons would have regarded as requiring operation.



As has been stated, the only case of fractured base that was operated upon, Case III, died as the trephine was started. He was a man of thirty-two, was having convulsions, and was sent to the operating room soon after being admitted. Following the advice of Doctor Frazier and others, no cases of fracture of the base are now operated upon within twenty-four hours of the time of injury.

Of the remaining cases of fractured base that were treated conservatively and died, the question naturally arises whether their chances for recovery would have been increased had an exploratory decompression been done. In this group, five died within twenty-four hours of admission, and two within forty-eight. It is presumably safe to say that each of these would have died in spite of any treatment. Of the others, three, classed as doubtful, lived four days; three for five days (one doubtful and two positive); one each for eighteen, twenty-three and twenty-five days, all "positive" cases. There are thus nine cases in which operation might possibly have been of benefit. Time and space prevent more than a brief résumé of these fatalities, sufficient to say that the surgeons in charge did not consider that operation was indicated.

In the "positive" class Case I was a man of fifty, who fell while under the influence of alcohol and was admitted in a semiconscious, very irritable condition. He was bleeding from the nose and both ears and showed weakness of the extremities on the left side, the facial muscle being weak on the right. The right pupil was dilated and immobile, the left contracted and reacting to light. He never recovered consciousness, the pulse varied from 48 to 116, temperature 96.3 to 102, and respirations 18 to 48. He died in two days.

CASE II.—A man of forty-two, fell out of a window, was irrational on admission, bleeding from left ear and post. pharynx, showed left facial palsy of the central type, and left hæmiplegia. Spinal fluid was bloody, under increased pressure, and the blood-pressure two days after admission was 140-95, and 120-70 on the fourth day. He died in five days.

CASE III.—A man of thirty-two, unconscious on admission, showed convulsions starting in the right hand and then extending over the entire body. He was taken to the operating room and died just as the operation was started. The skull was opened over the parietal region and no evidence of increased intracranial pressure was noted. This is the only case of fracture of the base that was operated upon.

CASE IV.—A man of forty-five, unconscious on admission, bleeding from the left ear, left pupil dilated and fixed, right moderately dilated. He was transferred to the surgical ward, never regained consciousness, and died the next day.

CASE V.—A man of seventy-two, having fallen, was unconscious on admission, bleeding from left ear and nose. He rapidly developed pulmonary oedema and died within a few hours. The history notes say that he was so sick that no examination, spinal puncture, etc., was made.

CASE VI.—A man of sixty-three, having fallen while drunk, was admitted in a stuporous condition. He was bleeding from both ears and pharynx. Spinal puncture showed blood-tinged fluid under normal pressure. He died in five days and post-mortem revealed a fracture of the parietal bone extending to the base.

CASE VII.—A man of forty-nine, was admitted, having received a blow on the head. He was apparently conscious, for the resident who made the notes does not state otherwise. Three days later his spinal fluid was bloody, the tension not being increased. Twenty-four days after admission it was clear and under

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normal pressure. He showed Battle's sign and the X-ray revealed a fracture extending from the occipito-parietal suture to the petrous portion of the temporal bone. He died on the twenty-fifth day.

CASE VIII.—A man of forty-seven, having fallen, was unconscious on admission. X-ray showed a fracture extending entirely across the cranium and middle fossa. He died on the eighteenth day and unfortunately there are no notes as to the progress of his condition.

CASE IX.—A man of fifty-one, admitted in a stuporous condition, bleeding from the right ear, right arm flaccid, some paralysis of the right facial muscles, other parts of the body spastic, eyes deviated to the left. X-ray showed fracture of the right parietal and middle fossa. He developed some retraction of the head and stiffness of the neck and died in forty-eight hours.

CASE X.—A man of thirty-two, fell and was semiconscious on admission. He showed bilateral subconjunctival hemorrhage and X-ray revealed fracture of the left frontal and anterior fossa. He also had a fracture of the femur. He gradually sank and died on the twenty-third day, showing signs of mental irritability up to the last.

The following four cases showed sufficient clinical evidence to be classed as fractures, but for the reason mentioned elsewhere they are included in the "doubtful" group.

CASE XI.—A man of forty-five, unconscious and alcoholic on admission, bleeding from the nose, both eyes diverging to the left, the left one more so, bloody spinal fluid, lines on left side of face smooth, developed a partial paralysis of the right arm and leg. The other reflexes were not exaggerated on admission. Temperature 100 to 107, pulse 100 to 162, and respiration 24 to 65 before death. X-ray failed to show fracture of the base.

CASE XII.—A man of fifty-three, unconscious from a fall, showed ecchymosis around the left eye. The right pupil was dilated and immobile, the left small, reacted to light and showed nystagmus. The right side of the body was spastic and the left flaccid. One hour after admission he moved the left side and the right was less spastic. Next day both sides were paralyzed and he died thirty-six hours after admission.

CASE XIII.—A man of sixty, fell while under the influence of alcohol, was violently irrational on admission and showed blood in the right orbit. There was no evidence of paralysis. He had a chronic nephritis and myocarditis and was delirious most of the time, till he died two days later.

CASE XIV.—A man of sixty, also fell while drunk, and was delirious on admission. There was bleeding into the right orbital fossa which increased up to the time of his death, four days later. His pulse ranged from 84 to 120. Temperature 101-104. X-ray failed to detect fracture of the base. Unfortunately spinal puncture and blood-pressure findings are not recorded.

In recording the results of treatment, Table IV, a patient was regarded as being cured when all symptoms had cleared up before leaving the hospital. Improved applied to those cases, mostly palsies, that had not entirely recovered, and not improved included those—mostly palsies—that had grown progressively worse or showed no evidence of improvement at the time of their discharge. The last group are those ending fatally.

An effort was made to interview all of the cases that left the hospital, but this met with only fair success. Lack of sufficient personnel in the Social Service Department renders it at present impossible to keep track of all the patients leaving the hospital, and for this reason, and the fact that most

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of our notices were returned unclaimed, we were only able to examine or hear from fifteen. This number is of course too small to warrant drawing any conclusions, but some of those examined were of interest. All of them had shown a definite fracture while in the hospital. Six were in good health at the time of our examination—four vault and two base—and had not been operated upon.

TABLE IV.  
*Results of Cases Operated and Not Operated Upon.*

	Operated upon				Not operated upon			
	Cure	Improved	Not imp.	Died	Cure	Improved	Not imp.	Died
Base { "Positive" . . . .	0	0	0	1	15	3	2	8
Base { "Doubtful" . . . .	0	0	0	0	6	1	0	5
Vault { "Positive" . . . .	10	0	1	5	28	1	0	3
Vault { "Doubtful" . . . .	0	0	0	0	0	0	0	1
Base and Vault . . . . .	0	0	0	0	7	0	0	3
	10	0	1	6	56	5	2	20

One, a boy of six, with a fracture of the base, whose hearing had been impaired, showed this condition cured, but he had lost the sense of smell. Of five who were regarded as improved when they left the hospital, one, a man who had shown involvement of the seventh and eighth nerves, on examination, showed that the seventh had cleared up and his hearing had returned in his right ear and was improving in the left one. Another, showing a palsy of the seventh when admitted two weeks after having been injured, had improved in seventeen days when discharged, and examination later showed a complete cure. The same was true for another palsy of the seventh which developed twelve days after the injury. This had almost cleared up when she was discharged in forty-one days, and follow-up examination showed complete recovery. A man who had shown mental dulness cleared up in nineteen days, and another, admitted five days after the accident, complaining of headaches and with left facial palsy, was somewhat improved when discharged. A man of thirty-three, unconscious for three days, developed a seventh nerve palsy on the seventh day, and was somewhat dull mentally. He cleared up mentally by the twenty-third day, but his palsy persisted. A man of twenty-nine, with a fracture of the base, who was partially deaf, reports his hearing as being much improved. A man of twenty-one, with a fracture of the base, had a facial palsy which cleared up, but at the time of examination complained of headaches, weakness in his right eye, irritability and forgetfulness.

The commonest complaint was more or less persistent headache, usually over the site of fracture if this was in the vault. A boy of eight, injured three years ago, had a fracture of the parietal bone and the base. While in the hospital he showed a paralysis of the seventh and eighth nerves on the left side, which cleared up before he was discharged. He has been in poor health since, has headaches, pains in the left ear, definite mental impairment, and his mother says he is incorrigible.

The other cases with complications cleared up while the patients were in the hospital and are classified as having been discharged cured. There were thirteen "positive" and three "doubtful" cases that suffered no com-

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plications other than being unconscious, irrational or bleeding, all of which cleared up without ill effects.

Thus of forty-seven fractures of the base, five of the "doubtful" and eleven of the "positive" type, died; fifteen with a fracture showing complications lived and sixteen uncomplicated cases lived.

The impression given from these observations—the series is too small

TABLE V.  
*Complications of Cases which Lived.*

	Cured		Improved				Not improved	
	Not operated upon		Operated		Not operated		Not operated on	
	Vault	Base	Vault	Base	Vault	Base	Vault	Base
Dizziness and head-ache.....	1	$\frac{1}{2}$ B	0	0	0	0	0	0
Hearing.....	0	$1\frac{1}{4}$ A	0	0	0	1	0	0
Mentality....	0	2	0	0	0	1	0	0
Vision.....	0	0	0	0	0	0	0	1
Paralysis....	0	$2\frac{1}{2}$ A	1	0	0	0	0	$5\frac{1}{2}$ B
Spastic.....	0	0	0	0	1	0	0	0

Of the 18 cases with complications which lived, 15 were of the base and 3 of the vault.

to warrant the term "conclusions"—is that the conservative or non-operative treatment of fracture of the base is the method to be preferred.

This consists chiefly in rest in bed, purgation and light diet. Should palsy of a cranial nerve—fourth, sixth, seventh or eighth—be present at the time the patient is admitted or subsequently develop, without evidence of pressure on more vital areas, we do not consider that operation is indicated for its relief. Many of these cases have cleared up spontaneously, and in those that persist it is felt the dangers accompanying a decompression outweigh its possible beneficial results.

We endeavor to keep a patient with even a simple uncomplicated fissured fracture in bed at least three weeks, although many of them object to such a procedure and demand their discharge earlier.

As a matter of form, one of the supposedly cerebrospinal disinfectants is usually administered, urotropine, etc., but we have not as yet seen an instance in which it has been proven of value. Likewise, no harm has resulted from its use.

Should signs of pressure develop which tend to progress and threaten life, exploratory decompression is of course indicated. When therefore an honest doubt exists as to the advisability of surgical interference, it would seem that equally good if not better results may be expected by following the non-operative course of treatment.

## CONGENITAL SOLITARY KIDNEY\*

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*Definition.*—The term solitary or single kidney should only be used in connection with cases in which there is a complete lack of development of the opposite organ. (A of Fig. 1.) Much confusion exists because not only older, but even recent writers, use the term "solitary" or "single" in describing the following conditions:

1. Cases of crossed ectopia. (Fig. 2.) Here both kidneys have developed but have fused into a single mass, lying, as a rule, entirely on one side of the midline of the body.

2. Cases of hypoplasia. (B of Fig. 1.) Here one kidney has failed to develop completely so that only microscopic evidence of its presence may exist in extreme cases. The normally developed kidney may thus be thought to be the only one.

3. Cases of cake kidney. Here both kidneys have fused to form a single mass, usually in the midline of the body. (Fig. 3.)

4. Cases in which one kidney has been removed are often erroneously referred to, both in our own and in foreign literature as "solitary kidney."

The existence of a rudimentary ureter on the opposite side (C of Fig. 1), or the fact that the ureter of the solitary kidney crosses the midline of the body to end in the opposite side of the bladder (Figs. 4 and 5), and finally the presence of a reduplication of the renal pelves and ureters in the solitary kidney, does not exclude the use of the term solitary or single in cases showing these variations.

*Frequency.*—The following statistics show much variation as to the frequency of the condition:

Donald Brown <sup>1</sup> .....	3 in 12,000 autopsies
Morris <sup>2</sup> .....	1 in 3,370 autopsies
Guizzetti and Pariset <sup>3</sup> .....	39 in 20,000 autopsies
Nauman <sup>4</sup> .....	10 in 10,177 autopsies
Sangalli <sup>5</sup> .....	3 in 5,348 autopsies
Rootes <sup>6</sup> .....	1 in 600 autopsies
Reinfelder <sup>7</sup> .....	1 in 400 autopsies
Motzfeld <sup>8</sup> .....	10 in 10,000 autopsies
Ballowitz <sup>9</sup> .....	1 in 617 autopsies
Engel <sup>10</sup> .....	16 in 12,300 autopsies

In 77,812 autopsies, the condition was found eighty-five times, or a little over one in a thousand. The earlier statistics include many cases of crossed ectopia, hypoplasia, and even horseshoe and cake kidney, so that I believe a more recent observation like that of Motzfeld gives us a fairly accurate idea of the frequency of the condition, *viz.*: about one in a thousand individuals.

\* Read before the Chicago Urological Society, November 22, 1923.



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*Sex and Side.*—It is rather difficult to draw any conclusions from autopsy reports as all who have made observations as to the relative frequency in males and females state that fewer autopsies are performed in women. From

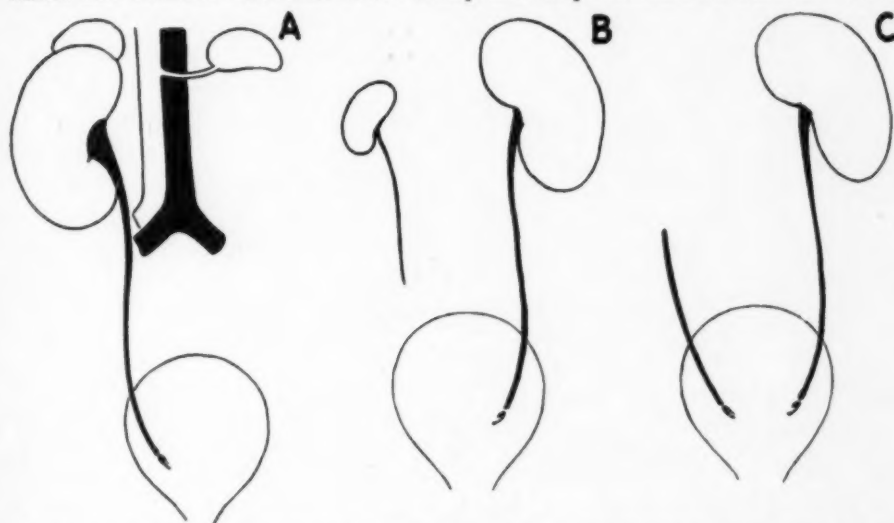


FIG. 1.—A. Ureter ends on same side as that upon which kidney is located. Note almost constant presence of adrenal. B. Kidney with normal ending ureter on one side, hypoplastic kidney with blind ending ureter on opposite side. C. Kidney with normal ending ureter on one side with more or less patent ureter and absence of kidney on opposite side.

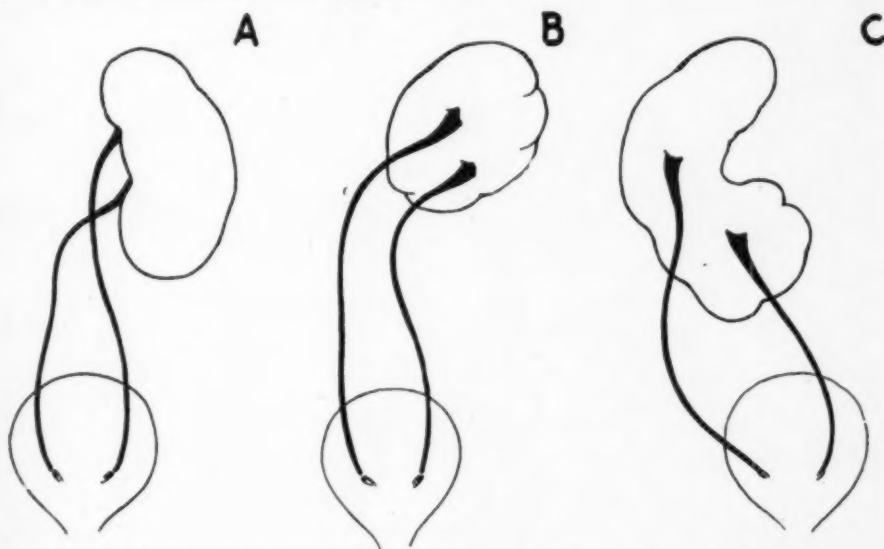


FIG. 2.—Various forms of crossed ectopia. Much confusion has arisen by describing such cases as "solitary kidney" or "unilateral fused kidney" (see text). A. The two kidneys are fused into a mass resembling the form of the normal kidney. B. Cake-like mass with pelvises on ventral aspect. C. L-shaped mass, on one side of median line of body.

a study of all of the reports on this phase of the question, we can conclude that the condition occurs more often in males and also on the left side.

*Number of Cases Reported.*—Ballowitz<sup>9</sup> was the first to collect a large series of cases. He reported 213 cases up to 1895. Anders<sup>11</sup> added 61 to

the largest number, 286 cases, which had been collected up to 1910. I have been able to find twenty-five recent additional cases, so that the total number of observations is about 400. Many of the older writers included the various anomalies which, as stated previously, should not be included in cases of true congenital solitary or single kidney, so that the total number is probably considerably less than the figures just given if one excludes such cases. The majority of reported cases have been autopsy findings. The number of

clinical cases (see tables) is only thirty-three.

*Anatomical Considerations.* 1. *Form, Size and Weight of the Single Kidney.*—As a rule, the form varies but little from that of the normal kidney. This applies to the organ when located in its usual position. In the reported cases of ectopia of the solitary kidney there is mention of much alteration in form, the organ being flattened and irregular, as is the case in congenitally ectopic kidneys in general. In comparatively few reports is the size mentioned. M. W. Lyon, Jr.,<sup>12</sup> states that in one case the measurements were 13 cm. in length, 8.5 cm. in width, and 4.5 cm. in thickness.

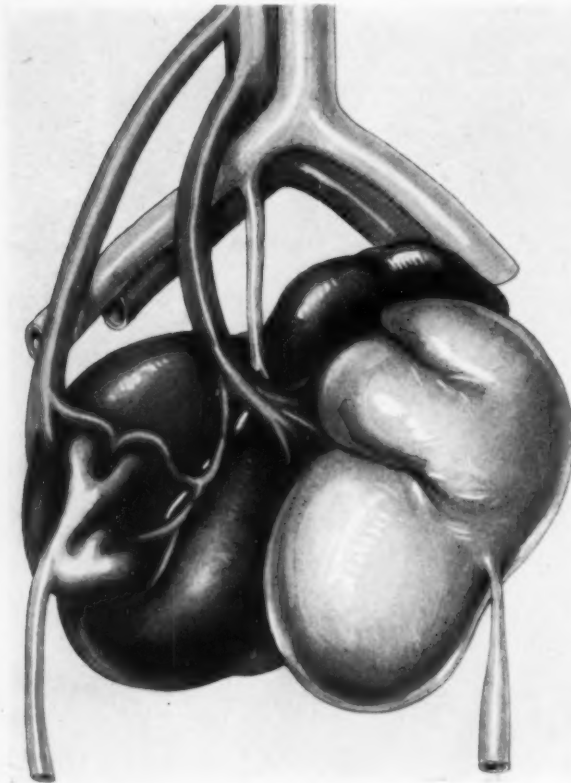


FIG. 3.—Hydronephrosis of left half of pelvic ectopic cake kidney (Heiner).

In the other case they were 14 cm., 7.5 cm. and 6 cm., respectively. Ballowitz gives similar dimensions to the first of Lyon's cases. In Jolly's case the kidney was 19 cm. in length while in Chassaing's case it was only 11 cm. long. Winter in 237 collected observations noted that the kidney was very small in five per cent. In a recent personal case the shadow of the kidney as measured on the röntgenographic film was 15 cm. long and 10 cm. wide. The average weight as reported is about twice that of the normal kidney.

2. *Location.*—As a rule this corresponds with that of the normal. (Fig. 6.) Exceptions are when the kidney lies over the spine (Fig. 7) or when it is ectopic (iliac or pelvic), (Fig. 8). Winter,<sup>14</sup> in a series of 237 collected cases, found the median location in two, the iliac ectopic location in three,

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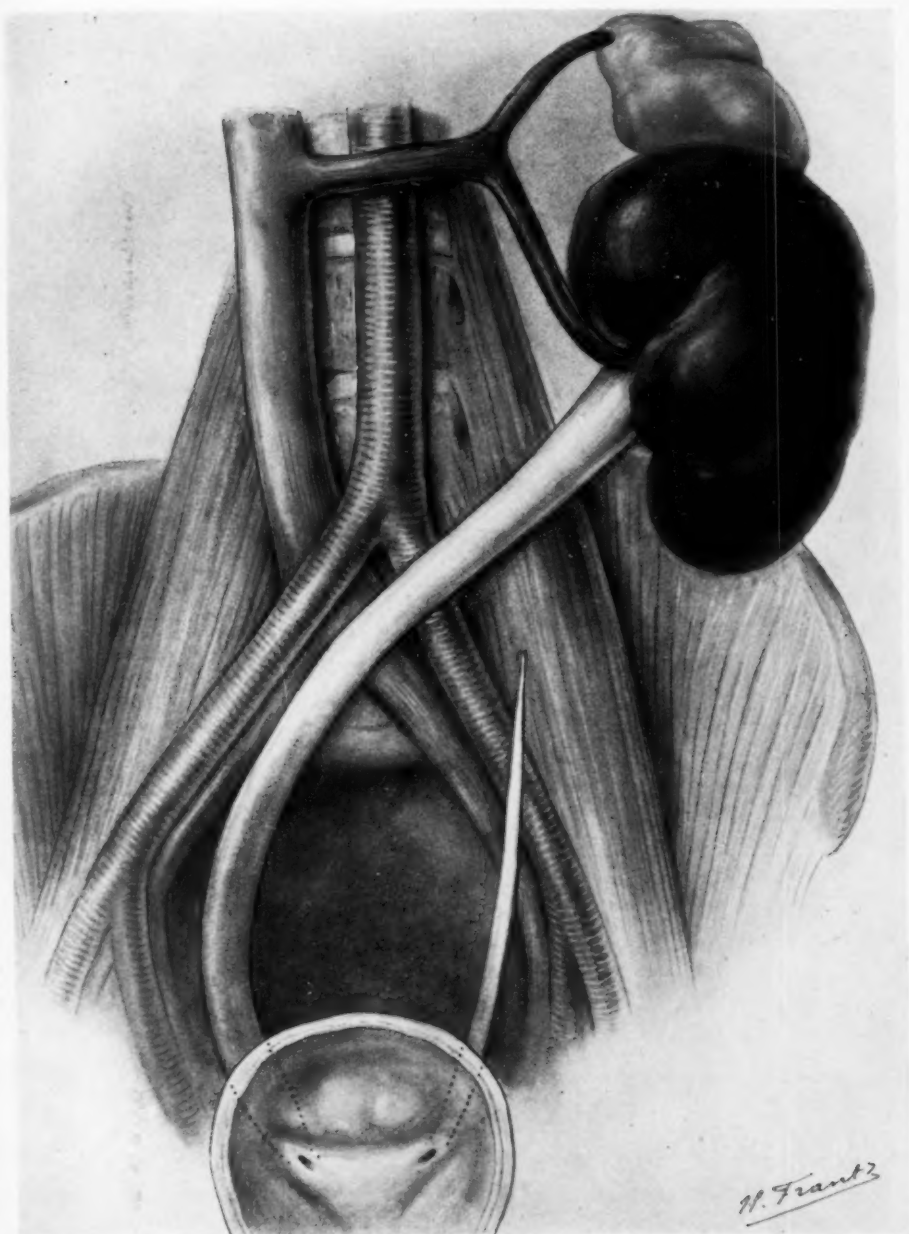


FIG. 4.—Unusual ending of ureter of congenital solitary kidney (Horand). Ureter of left solitary kidney crosses median line to end at right ureteral orifice. Left patent rudimentary ureter ends normally below but blindly above. Left seminal vesicle was absent.

and the pelvic ectopic location in five cases. I have found two additional median (Chavannaz and Rubens-Duval), three pelvic (Schultz, Buss and Strube) and one iliac (Heinricius) case. Papin<sup>13</sup> states that he was able to find reports of fourteen cases of ectopia of the solitary kidney.

3. *Variations in the Course and Ending of Ureter of the Solitary Kidney.*—Instead of the ureter ending on the same side of the bladder (Fig. 6) as that upon which the kidney is situated, three variations may exist:

(a) The ureter may end in the midline of the bladder. (Fig. 9.) This occurred in seven cases.

(b) The ureter may cross the midline and end in the opposite side of the bladder. I could only find three reports of such an ending, the cases of

Lyon-Caen and Marnier,<sup>15</sup> Horand<sup>16</sup> and Förster.<sup>17</sup> (Figs. 4 and 5.)

(c) The ureter ends in the posterior urethra. Schultz<sup>18</sup> states that such a case has been reported, but I have been unable to find it.

4. *Ureter of Opposite Side (Ending at Usual Place, i.e., Opposite Orifice).*—This is of much importance from the clinical standpoint because the presence of two ureteral orifices does not necessarily mean that two kidneys are present. The ureter on the side opposite to that upon which the solitary kidney is situated may vary from a shallow depression or pouch to one which is patent for nearly half the length of



FIG. 5.—Ureter of solitary kidney crossed midline to end in opposite side of bladder (Förster). U. Ureter. TT. Undescended testes. R. Rectum. Note how ureter passes behind rectum.

the normal ureter. In sixty-one cases Anders (*loc. cit.*) found the ureter absent in forty-two, more or less patent in ten, and the condition not mentioned in nine reports of cases. Winter found that the opposite ureter was present for a distance of at least a few centimetres in 18 of 237 cases. I have found mention of the condition of the opposite ureter in a number of reports. These are of much practical importance. In Jolly's case it was patent for 1 cm. and represented by a fibrous band for 13 cm. In Winter's case it was patent for 8 cm., in Nebelow's case for 3 cm. In Thevenot's case it was patent for half its normal length, while in five cases it was represented by a shallow cul-de-sac located at the place where the ureteral orifice should be.

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5. Ureter of opposite side (abnormal endings). Instead of a rudimentary ureter (C of Fig. 1) ending at the usual location of the corresponding ureteral orifice, the ending of the opposite ureter may be extravascular. It may end in the seminal vesicle<sup>19</sup> (Fig. 10) or form an intravesical protrusion<sup>20</sup> (Fig. 11) or finally end in the wall of the cervix of a bicornuate uterus or in one horn of the latter.<sup>21</sup> (Fig. 12.)

6. Reduplication of the pelves and ureters of the solitary kidney. Papin (*loc. cit.*) quotes five cases in which this condition existed. In all of these both ureters ended on the same side of the bladder as that upon which the solitary kidney was located.

7. Condition of the bladder trigone. The trigone may be either symmetric or asymmetric. In the former the interureteric ridge or ligament is developed as in an individual with two normally placed and developed kidneys. Instead of finding a ureteral orifice at both angles of the trigone the angle corresponding to the side upon which the kidney is absent, fails to show an orifice, often only an anæmic area taking its place. In the asymmetric trigone (Fig.

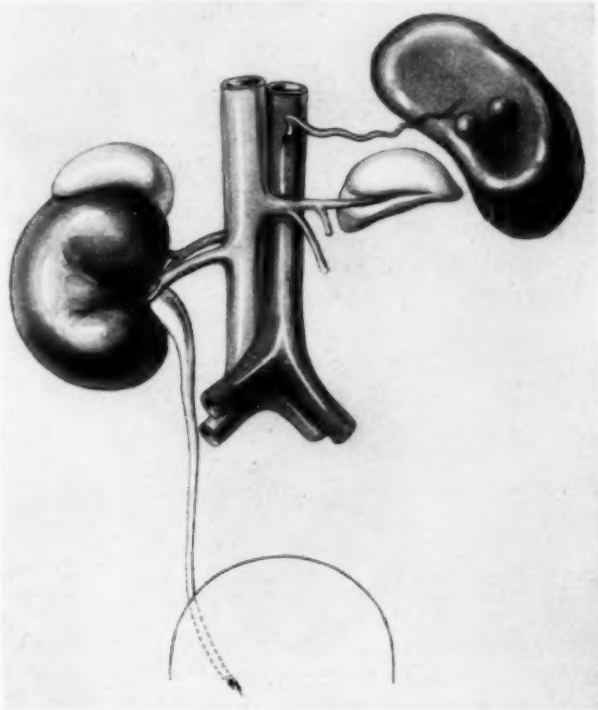


FIG. 6.—Typical findings in true congenital solitary kidney. Note ending of ureter on same side of bladder and presence of opposite adrenal (Renda).

13) the interureteric ligament flattens out into the wall of the bladder and only a few vessels indicate where the orifice should have been located.

In connection with this finding of a single ureteral orifice at one angle of the trigone, one must not fail to bear in mind such a case as that of Hepburn,<sup>22</sup> in which there was a single ureteral orifice normally located but two kidneys. (Fig. 14.) The ureters from these united before entering the bladder.

8. Adrenals. These are absent in from ten to twenty-five per cent. of the cases according to various reports.

*Associated Genital Defects.*—If one recalls the fate of the various structures which are present in the embryo (Fig. 15), it is easy to understand



how genital defects † are associated with absence, lack of development, or malposition of the kidneys. We will first consider those which are found in the male sex.

(a) *Genital Defects in the Male.*—The recent statistics of Guizzetti and Pariset<sup>3</sup> and of Engel<sup>20</sup> are more accurate as to the relative frequency of these defects than the older statistics of Ballowitz and Winter, because the

latter do not distinguish as was explained above between solitary kidney, hypoplasia and crossed ectopia. Guizzetti and Pariset in a total of 39 autopsies on cases of solitary kidney, found defects of the male genitalia in 6. Engel in 16 solitary kidney autopsies found defects in 10 of 13 males. These defects in the male may occur alone or in any combination.

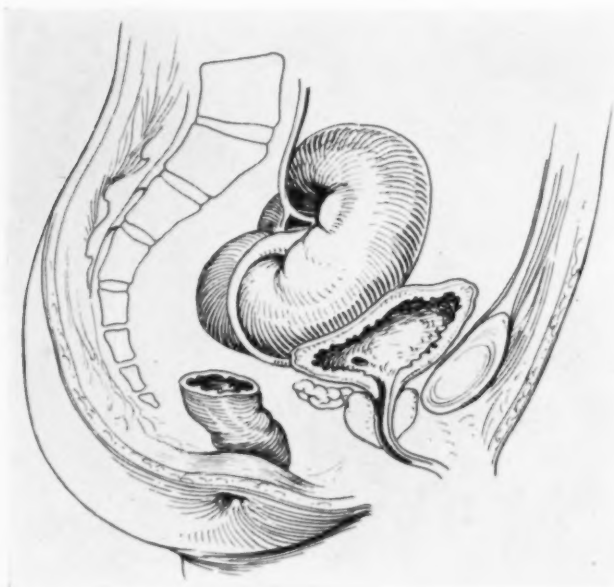


FIG. 7.—Pelvic ectopic solitary kidney. Pelvis directed to right. Ureter entered midline of bladder. Compare with Fig. 9 (Schultz).

1. Rudimentary or absent seminal vesicle on the side where the kidney is absent.

2. Rudimentary or absent vas deferens with or without a corresponding defect of the seminal vesicle.

3. Atrophy of the prostate on the side of the renal defect.

4. Absence of the ejaculatory duct on the side of the renal defect.

5. Rudimentary or absent epididymes.

6. Atrophy or absence of the testis. The latter condition is rare.

7. Absence of the seminal vesicle or of the testis on the side upon which the solitary kidney lies. This only occurs in cases where the ureter crosses to end in the opposite side of the bladder. In Horand's case the seminal vesicle was absent on the solitary kidney side.

8. The rudimentary ureter ends in the seminal vesicle or in the vas. This has been referred to in the description of the ending of the ureter on the opposite side. (Fig. 10.)

† This diagram will aid in understanding how the ureter can end in the seminal vesicle. The ureter is a bud from the Wolffian duct which becomes the vas deferens in the male. In the female, the Wolffian duct disappears but from the duct of Müller develop the uteruses and tubes.

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9. Associated defects of the external genitalia, *e.g.*, hypospadias, non-descent of the testis, pseudo hermaphroditism.

(b) *Defects of the Female Genitalia.*—Guizzetti and Pariset found defects in 5 of 39 cases (both sexes) of solitary kidney. Winter, in a total of 237 collected cases of solitary kidney (some of which were undoubtedly other renal anomalies), found that nearly one-third had defects of the female genitalia.

Eismayer<sup>1</sup> has recently collected 122 cases of genital defects in the female associated with solitary kidney. These defects in the female may occur alone or in any combination.

### 1. Uterine defects.

- (a) Uterus unicornis with or without (Fig. 16) rudimentary second horn.
- (b) Bifid uterus.
- (c) Uterus didelphys.
- (d) Uterus duplex. (Fig. 12.)

### 2. Tubal defects.

- (a) Absence of the tube on the side of the renal defect (very rare).
- (b) Rudimentary tube or only abdominal end present.

### 3. Ovarian defects.

- (a) Absence (very rare).
- (b) Atrophy—associated with similar condition of the corresponding tubes.

### 4. Vaginal defects.

- (a) Absence or rudimentary development.
- (b) Atresia.
- (c) Double.
- (d) Recto-vaginal fistula associated with atresia of the rectum.

5. Defects of the external genitalia, *e.g.*, absence or rudimentary development of clitoris or labiæ.

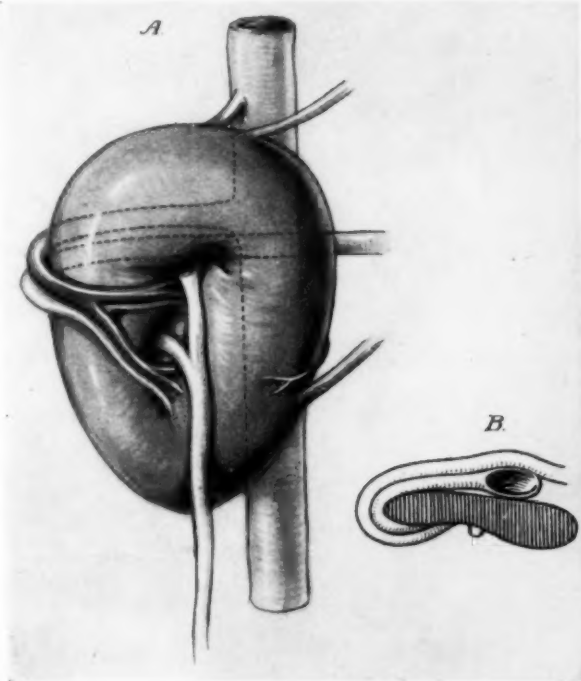


FIG. 8.—Ectopic median solitary kidney lying over aorta (Lejars and Rubens-Duval). Note how vessels wind around right edge of kidney to enter pelvis. A. Anterior view. B. Relation of aorta and vena cava to kidney.

6. Abnormal ending of the rudimentary ureter in the wall of the cervix or in one horn of a bifid uterus. Two such cases have been reported by Weibel. (Fig. 12.)

It is of interest to quote some statistics regarding the frequency of some of these defects in the female.

WINTER—237 cases of solitary kidney. In 3 absence of the uterus, in 2 absence of the vagina, in 4 absence of the ovary, in 2 a double vagina.

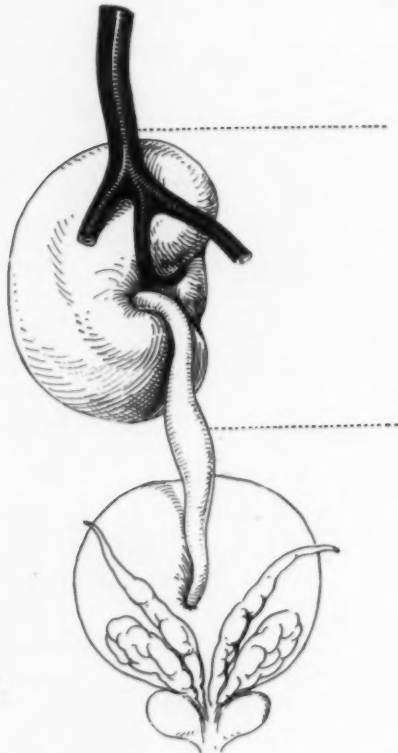


FIG. 9.—Posterior view of pelvic ectopic solitary kidney whose ureter ended in midline of bladder. Compare with Fig 7. (Schultz.)

GUIZZETTI and PARISSET—in 39 cases of solitary kidney. One uterus bicornis, two uterus unicornis, one had absence of vagina and uterus and one the same condition plus absence of the tubes.

BALLOWITZ—in 213 cases solitary kidney. There were 18 cases of uterus unicornis and 10 of bifid uterus.

BOLAFFIO<sup>24</sup>—in 99 collected cases of defects of the female genitalia associated with renal anomalies there were noted:

Uterus unicornis with opposite rudimentary horn—12 of 13 had a solitary kidney.

Uterus unicornis without opposite rudimentary horn—19 of 24 had a solitary kidney.

Uterus bicornis—25 of 34 had a solitary kidney.

Rudimentary uterus—10 of 19 had a solitary kidney.

Absence of the tubes alone—3 of 3 had a solitary kidney.

This shows that female genitalia

defects occur far more often in connection with complete lack of development of the kidney than in association with any other renal anomaly.

*Clinical Considerations.*—The importance of being able to recognize the presence of a congenital solitary or single kidney (as defined above) cannot be underestimated. With our present diagnostic resources this should be possible in a far larger number of cases than in the past. The kidney in these individuals is subject to the same diseases and injury as when two organs are present at birth. In the case of congenitally displaced forms of solitary kidney (median, iliac or pelvic) there are the same predisposing mechanical factors to such conditions as calculus formations and hydronephrosis, as one finds in other congenital anomalies (horseshoe kidney, ectopia, hypoplasia and crossed ectopia). The menace to the carrier of the blocking of his or her

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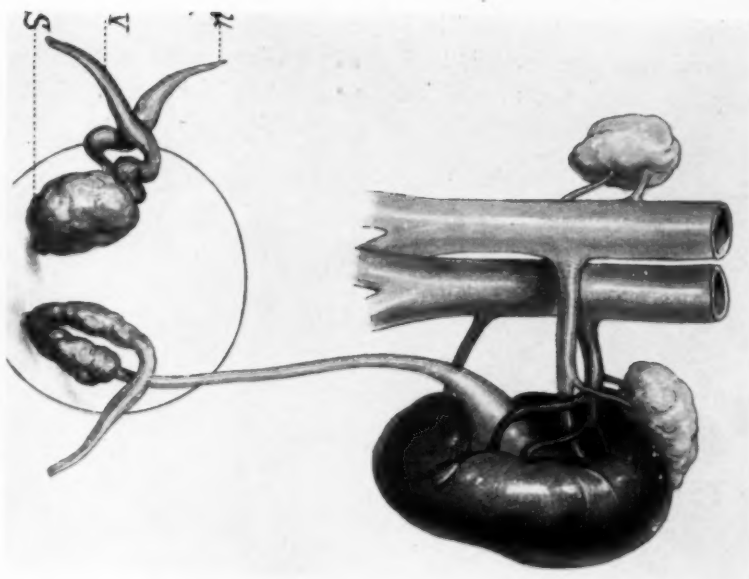


FIG. 10.—Opposite rudimentary ureter. U, Ends in seminal vesicle. VS, Vas deferens (Erhardt Schmidt).

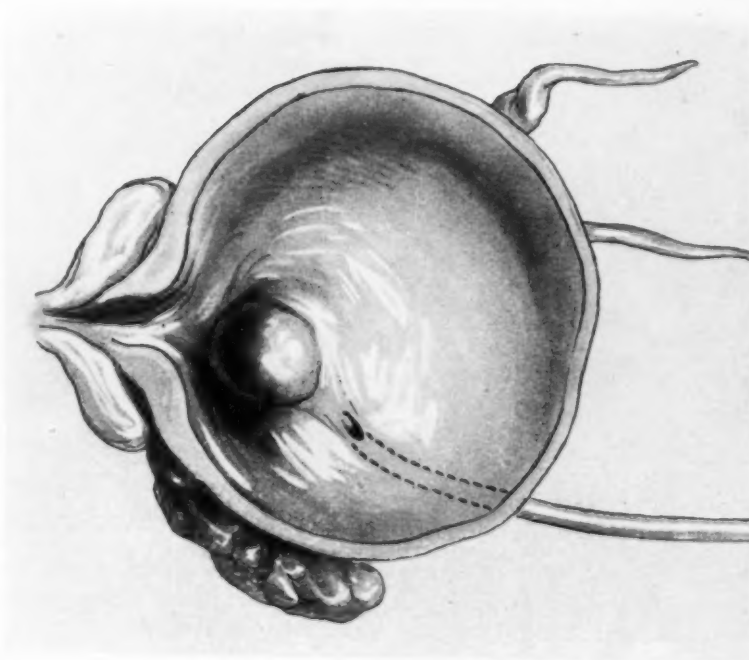


FIG. 11.—Opposite ureter ends in seminal vesicle which forms intravesical protrusion (Desider Engel).

only kidney by some form of obstruction, emphasizes the necessity of an early diagnosis of such a possibility.

A review of all of the published cases reveals the fact that a diagnosis before operation or the inception of non-operative measures has only been made in so few cases that an additional one may be of interest.



FIG. 12.—Associated genital and renal anomalies (Weibel's cases). Case A. View of rudimentary ureter ending in wall of cervix. The opposite kidney (solitary) and ureter were normal. Case B. View of rudimentary ureter ending in dilated cervical canal. The opposite kidney (solitary) and ureter were normal.

Male, forty-nine,‡ first seen with Dr. Frank Wright on account of a hæmaturia in April, 1923. There was a history of influenza and recurrent tonsillitis. Two weeks after an attack of the latter, hæmaturia was observed. Aside from a hypospadias (opening just behind glans penis) physical examination revealed nothing abnormal. A much reddened trigone and a moderately enlarged prostate

‡ This case has been reported in abstract form elsewhere.



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was found at the cystoscopic examination in April, 1923. Clear urine was observed to escape from the normal appearing left ureteral orifice and the notation made at the time that the right orifice was very difficult to find. Ureteral catheterization was postponed to a second sitting, but inasmuch as radiography revealed no abnormal shadows indicative of calculi and there was a temporary cessation of the hæmaturia, the patient did not return for further study. The hæmaturia recurred at intervals during the interval between the above examination and September 3, 1923, when he was again seen with Dr. Lester E. Garrison about twelve hours after the onset of such severe left colicky abdominal pain that opiates gave no relief. Shortly after admission to the Michael Reese Hospital, late the same evening, the



FIG. 13.—Asymmetric trigone with absence of left ureteral orifice in congenital solitary kidney (Baetzner).

chief complaint was a persistence of this pain localized in the lower left quadrant of the abdomen and radiating towards the left kidney region. The bladder was found to contain only 8 c.c. of a bloody fluid. A tentative diagnosis of left calculous anuria was made and active interference postponed until the next morning, as it was deemed safe to wait another twelve hours in order to have another röntgenogram made.

No abnormal shadows indicative of calculi were found, but it was noted that the shadow of the left kidney was very large. It measured 15 cm. in length and 10 cm. in width. The bladder contained only a few drops of bloody fluid. Cystoscopy revealed a slightly prominent left ureteral orifice, but no right-sided opening could be found. The trigone was symmetric and at its right angle was a pale area where the orifice should be located. A number five ureteral catheter after meeting with resistance in the pelvic portion of the ureter, could be passed to the kidney. At first a bloody fluid escaped, followed by a steady flow of clear urine in large amount. The abdominal pain and the anuria having been relieved, further search was made in all portions of the bladder and posterior urethra for a

second ureteral orifice. None was found and indigocarmin, although excreted in fair concentration from the left ureteral catheter, was not observed to escape elsewhere.

During the next twelve hours 250 c.c. of urine was collected from the left inlying ureteral catheter and a further 800 c.c. during the following twenty-four hours. Nausea and vomiting ceased as soon as the anuria was relieved. The absence of a right ureteral orifice was confirmed by Dr. Frank M. Phifer at a later cystoscopy at which indigocarmin again failed to be excreted on the right side of the bladder. The left ureteral catheter was withdrawn on the third day, but it was necessary to reinsert it because the anuria and abdominal pain recurred.



FIG. 14.—Diagram of Hepburn's case in which the two ureters united to end in a single ureteral orifice. (See text.)

On the fourth day the catheter became blocked so that a left pyelotomy or ureterotomy became imperative. The latter operation seemed preferable in order to determine the nature of the obstruction in the left ureter. The latter was found greatly distended and thin-walled down to a segment about one inch in length just above the bladder. This portion was very much smaller, indurated and impermeable. In order to exclude the possibility of overlooking a small calculus, the bladder was opened through a second suprapubic incision and a retrograde attempt to pass the blocked segment of the pelvic ureter. Inspection at this time of the right side of the bladder also failed to reveal the presence of a right ureteral orifice. The ureterostomy relieved the pain and anuria which had followed the occlusion of the inlying ureteral catheter on the fourth day. Although a large quantity of urine was passed through the ureterostomy wound, not a drop escaped for the first five days through the suprapubic drain. This was an indirect confirmation of the presence of a left solitary kidney.

At the above operation only a single ureter could be seen. Only the lower pole of the left kidney could be felt, but it was in its normal location.

The patient made an uneventful recovery. At subsequent examinations the absence of a right ureteral orifice and the failure to excrete indigocarmin on this side again noted. The cause of the hæmaturia during the five months preceding the anuria and the latter as well, were deemed to be due to a stricture in the pelvic ureter. In all probability this was secondary to a tonsillar infection. No attempt has been made at urography. The stricture is being dilated at intervals. At the last sitting (November 19, 1923) a No. 7 ureteral bougie after meeting with slight resistance could be passed to the kidney, but a No. 8 bougie could only be inserted for a distance of 15 cm. A mild infection due to *B. coli* has necessitated lavage of the left kidney pelvis upon two occasions.

In the accompanying tables, I have collected all of the published cases of true congenital solitary or single kidney, which have either been operated or in which an anuria has been relieved by non-operative measures. All reports in which there was no proof that a solitary kidney had been present were eliminated.

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TABLE I.—*Operated or Catheterized Cases without Anuria.* There were eleven cases. It is of interest to note that in six of these only one ureteral orifice was found. In one case (Suter) the opposite ureter was patent for one-half cm. In another (Cohn) there were two normally placed orifices but no efflux from one of these. In two, cystoscopy was not done on account of bladder intolerance.

The treatment in these cases varied from catheter drainage (Bugbee and Losee) to pyelotomy and nephrotomy. In one case (Schultz) only an exploratory was performed.

TABLE II.—*Cases of Anuria in Solitary Kidney.* This embraces 16 cases including our own. The duration of the anuria is only mentioned in nine cases. It

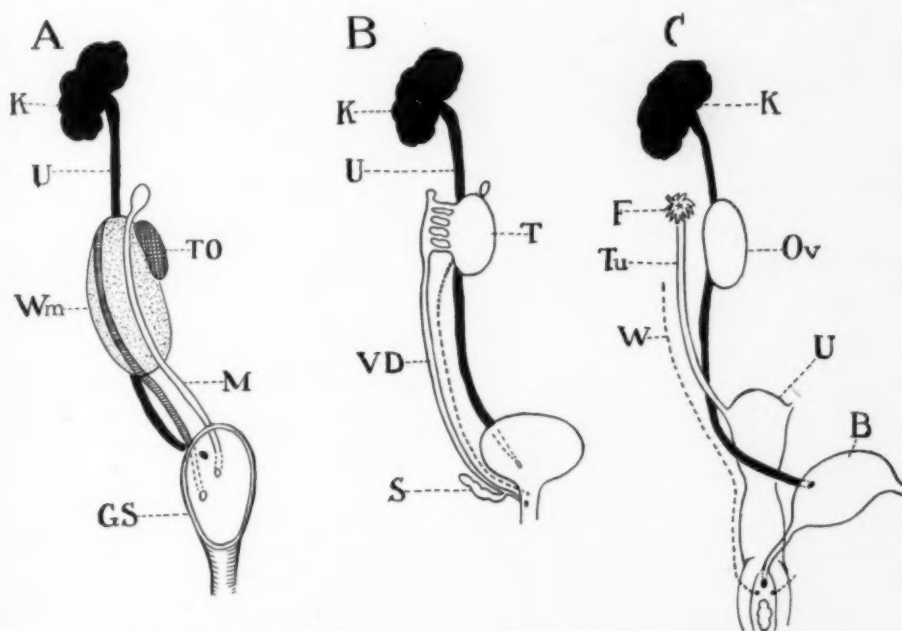


FIG. 15.—Diagrams showing transformation of internal genitalia in the human embryo into those of male and female respectively. (After Merkel and Corning.) A. Undifferentiated stage. K, Kidney. U, Ureter. TO, Undifferentiated genital gland. Wm, Wolffian duct (primitive kidney). M, Mullerian duct. GS, Urogenital sinus. B. Male type. K and U as in A. T, Testes. VD, Vas Deferens. S, Seminal Vesicle. C. Female type. K, Kidney. Ov, Ovary. F, Fimbriated end of tube (Tu.). W, Obliterated Wolffian duct ending at vestibule. U, Uterus. B, Bladder.

varied from twenty hours (Castano) to nine days (Wyss and Krönlein), indicating, as is well known, that the period of tolerance is sufficiently prolonged to justify attempts to relieve the anuria during the first three or four days by ureteral catheterization alone. No attempt was made to relieve the anuria in the case in which it lasted nine days (Wyss and Krönlein). Ureteral catheterization was employed in seven cases. It sufficed to relieve the anuria permanently in the cases of Krebs, André, Gorach and Heyman, but in three cases (Heitz-Boyer and Eliot, Castano and our own) it was necessary to employ operative measures because the anuria recurred after withdrawal of the ureteral catheter. Eight cases were operated primarily. Six of these died shortly after operation. One died six years after the first operation and in one case the prognosis was considered very bad. The four cases treated by ureteral catheterization alone, all recovered, while in the three which required later operations there was one death and two recoveries (Castano and our own). In the fatal case of anuria (Heitz-Boyer and

Eliot), treated by primary ureteral catheterization and later operation, death was due to bronchopneumonia after four weeks. At autopsy a calculus was found blocking up the left single ureter. If ureterotomy had been performed in this case instead of nephrostomy, the chances for recovery would have been better.

A comparison of the results of those treated primarily by operative measures with those in which the anuria was permanently or temporarily relieved by ureteral catheterization speaks for the advantages of the latter method of treatment. In only eight of the sixteen cases in this second table was a

diagnosis of probable anuria in solitary kidney made before operation or other treatment. Three of these were reported in 1905, 1910 and 1911, respectively, while the other five appear in the literature since 1917, four during the past two years. This shows that the clinical importance of a knowledge of the existence of congenital anomalies of the upper urinary tract is beginning to be better appreciated.

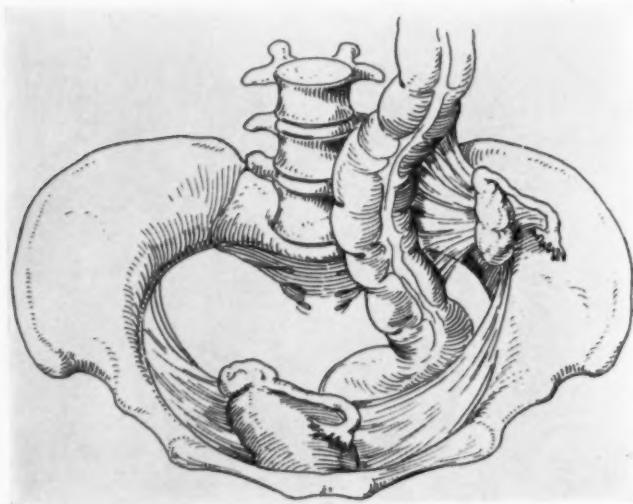


FIG. 16.—Solitary kidney and genital defects. Autopsy findings in girl of eighteen. Absence of left kidney, adrenal, ureter and blood vessels. Right single horned uterus. Rudimentary left horn. Left tube and ovary in iliac fossa, close to pelvic inlet (Hoenigsberg).

TABLE III.—Cases in Which Nephrectomy was Performed. This is only of historical value and should not be judged too harshly, inasmuch as the present more or less routine urologic study of an abdominal case was seldom carried out. It impresses one, however, even at the present day with the fact that the possible existence of a single kidney should be constantly borne in mind by the gynecologist as well as the general surgeon.

*Diagnosis and Treatment.*—The recognition of the presence of a single kidney depends chiefly upon the cystoscopic examination. As was stated above, the trigone may be symmetric or asymmetric. If the latter condition exists, the attention of the examiner would be attracted at once, but if the trigone is perfectly symmetric and especially if a normal appearing ureteral orifice presents at the normal location of such an orifice on the side opposite to that of the solitary kidney, one could easily be led astray. This would be especially true of cases where a rudimentary ureter is present on the opposite side and is patent as has been the case in a number of reports, for variable distances. If a ureteral orifice is not found at the normal location the first duty of the cystoscopist is to look in other portions of the bladder and even

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in the posterior urethra for the abnormal ending of a ureter. In addition to extravesimal openings in the urethra one must bear in mind the possibility in the female of such an opening in the vestibule, anterior wall of the vagina, or in

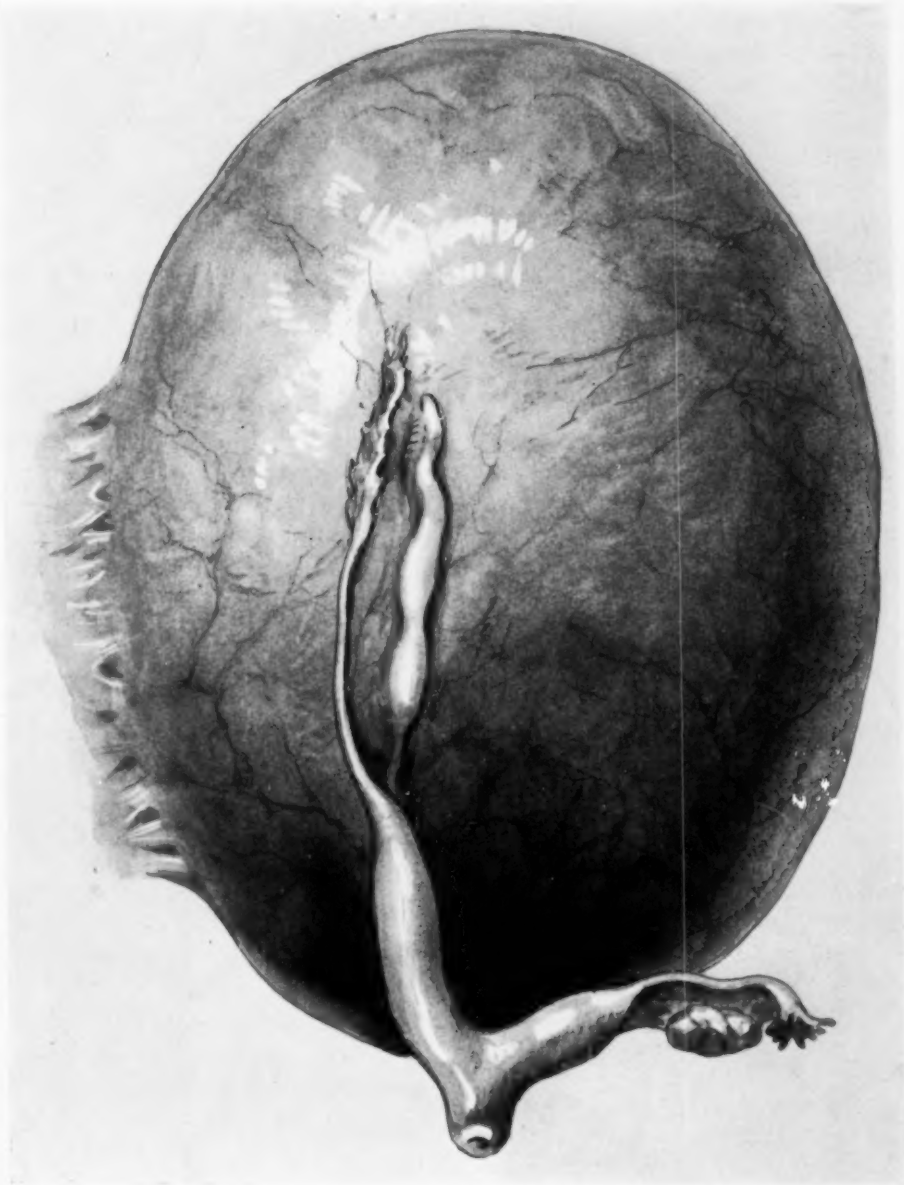


FIG. 17.—Hydronephrotic median solitary kidney with bicornuate uterus (R. Keller).

a submucous cyst. One of the most valuable aids is the injection of indigo-carmin, the excretion of which will aid in locating the missing orifice. In cases suspected to be congenital single kidney and not presenting the symptoms of anuria, urography will also be of great aid. The same is true of radiograms



with X-ray catheters *in situ*. Even in the presence of anuria of not more than four days' duration, search should be made at once for the presence or absence of a second ureteral orifice. The diagnosis of anuria in an individual possessing congenitally only one kidney presents no features which distinguish it from that of anuria in general, except perhaps the tendency to recurrence of the symptoms unless the obstruction is overcome. Of great value perhaps in the future will be the observation of the size of the kidney shadow in the röntgenogram and the fact that it is only present on one side, as is true of our case. The size alone is not a criterion unless it is very large, because the kidney in a certain proportion of cases is approximately normal in size.

The treatment of cases which do not present the symptoms of anuria differs in general but little from the methods which one would employ in the case of a person having two kidneys. The tendency should be towards the most conservative measures. The treatment of cases with symptoms of anuria should be equally conservative in the beginning. Ureteral catheterization should be employed as early as possible. As soon as the crisis is over operative measures such as ureterotomy or pyelotomy should be considered. If, however, the anuria recurs as it did in our own case, it may be necessary to operate earlier. I do not consider the operative measures should be employed, however, until ureteral catheterization has been given a fair trial. The patient is a far better risk for an operation to deliver a calculus or drain a kidney after the retention products incident to the anuria have been eliminated from the blood and tissues. One cannot depend upon any average period of tolerance, hence early diagnosis and ureteral catheterization must be the key to success in the future.

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# CONGENITAL SOLITARY KIDNEY

TABLE I.  
*Operated or Catheterized Cases of Single Kidney without Anuria.*

No.	Reported by	Pre-operative findings	Treatment	Results
1.	Verhoogen..... (quoted by Winter)	Female with disturbances of urination for 3 years. Cystoscopy not done on account of bladder intolerance. Urine contained tubercle bacilli. Right kidney enlarged	Nephrotomy (right)	Died 24 hours after operation. Absence of left kidney at autopsy.
2.	Thelen..... Zeit. f. Urol., vol. ii, p. 145, 1908	Pyuria and pain over right kidney. Cystoscopy revealed pus escaping from right ureteral orifice. No left orifice visible and no indigocarmine from this side of bladder	Removed large calculus from pelvis of right kidney. Failed to find opposite (left) kidney upon exposing this side	Recovery.
3.	H. Kummell..... Berl. Kl. Woch., Apr. 19, 1909, vol. xlv, p. 718	Male 45. Sudden onset hæmaturia and of large right abdominal tumor. Cystoscopy revealed absence of left ureteral orifice. Bloody urine from left ureteral catheter. Large shadow of right kidney, none of left. Small calculus shadow in region of renal pelvis. Symptoms of uremia on admission	Pyelotomy. Small calculus removed from right renal pelvis	Death from nephritis of right single kidney. No left kidney found at autopsy.
4.	F. R. Hagner..... J. A. M. A., Oct. 30, 1909, vol. iii, p. 1481	Female 40. History of recurrent left colics with passage of calculi. Cystoscopy revealed absence of right ureteral orifice. Opposite (left) orifice gaped and turbid fluid escaped	At operation found left pyonephrosis	Died 9 days after operation. At autopsy no left kidney found.
5.	Suter..... Handbuch d. Inn. Med., vol. iii, Part 2, p. 1743	Male 24. Diagnosis of calculus hydronephrosis of congenital single kidney made before operation. Left ureter patent for one-half cm., but no function. Stricture in opposite (right) ureter at ureteropelvic junction	Nephrotomy	All urine escaped from nephrotomy incision.

TABLE I.—Continued  
*Operated or Catheterized Cases of Single Kidney without Anuria.*

No.	Reported by	Pre-operative findings	Treatment	Results
6.	Bugbee and Losee. . . . . Surg. Gynec. and Obst., Feb., 1919, vol. xxviii, p. 97	Female 20. Pain and mass right lower quadrant. Cystoscopy revealed ab- sence of left ureteral orifice. Pus and red cells from opposite (right) ureter	Catheter drainage followed by clearing up of the urine from right (single) kidney	Recovery.
7.	Bugbee and Losee. . . . . Surg. Gynec. and Obst., Feb., 1919, vol. xxviii, p. 97	Female 33. History of hematuria and passage of two calculi. Cystoscopy revealed absence of left ureteral ori- fice. Diagnosis made of calculus ob- structing left uretero-pelvic junction	Pyelotomy	Recovery.
8.	Schultz. . . . . Beitr. z. Klin. Chir., vol. cii, p. 1, 1918	Male 18. Sudden onset of pain and suprapubic tumor	Laparotomy revealed a large ex- traperitoneal tumor in true pel- vis found to be infected ectopic kidney	Died seven days after operation. Autopsy revealed single kidney lying in true pelvis with ureter ending in median line of bladder.
9.	Theo. Cohn. . . . . Zeit. f. Urol. Chir., vol. v, p. 1, 1920.	Male 21. Trauma followed by right hydronephrosis. Cystoscopy re- vealed two normally placed ureteral orifices but no efflux from left	Drainage of right hydronephrosis	Death ten days after operation. Two normally placed ureteral orifices found at autopsy but left ureter ended blindly above Right hydronephrosis (trauma- tic).
10.	Betzner. . . . . Monograph on Kidney Sur- gery. Berlin, 1921	Female 44. History of recurrent hema- turia. Cystoscopy revealed absence of left ureteral orifice. Pus and blood escaped from right ureteral catheter	At operation found right pyone- phrosis	Outcome not given.
11.	Venzmer. . . . . Zeit. Urol. Chir., vol. vi, p. 162, 1912	Male 42. Colicky (left) pains. Urine turbid and at times bloody. Unable to catheterize right ureter. Obtain- ed pus and red blood cells from left kidney. Negative X-ray	Removal of calculus from pelvis of left kidney	Died of uremia about four weeks after operation. Absence of right kidney at autopsy.

# CONGENITAL SOLITARY KIDNEY

TABLE II.  
*Cases of Congenital Single Kidney with Anuria.*

No.	Reported by	Previous history and findings	Treatment	Results
1.	Springorum . . . . . Munch. Med. Woch., vol. viii, p. 220, 1899	Anuria in case of right renal calculus	Nephrotomy	Death on day after operation. Autopsy revealed large right single kidney with impacted ureteral calculus.
2.	Wyss and Krönlain. . . . . Beitr. z. Klin. Chir., vol. xxxii, p. 54, 1901	Male 44. Two previous attacks of anuria lasting 4 to 6 days. Seen on ninth day of anuria during third attack	Laparotomy revealed much enlarged left kidney. Nothing done	Died two days after operation. At autopsy found calculus blocking ureter of only (left) kidney.
3.	Krebs, Russki Wratsch. . . . . No. 18, 1903. Quoted by Owtschinnikow, Monats- bericht für Urologie, vol. x, p. 63, 1905	Anuria (details not given). Cystoscopy revealed absence of right ureteral orifice	Relieved anuria by catheterization of left ureter	Recovery.
4.	Schwartz. . . . . Zent. für Chirurgie, 1905	Pain in left upper quadrant and anuria	Pyelotomy for calculus	Death from pyelonephritis. No right kidney found at autopsy.
5.	Adrian. . . . . Folia Urologica, vol. viii, p. 182, 1908	Male 37. Sudden onset of anuria and enlarged right kidney	Nephrotomy by Madelung. Post-operative cystoscopy revealed only one ureteral orifice viz.: right. Ureterotomy one year later for calculus but all urine escaped through ureteral fistula (right)	Died of urosepsis six years after second operation. Autopsy revealed calculus pyonephrosis and stricture of ureter close to renal pelvis. Absence of left kidney, ureter and corresponding half of trigone of bladder. No genital defects.
6.	Heitz-Boyer and Eliot. . . . . Bull. Soc. Anat., vol. lxxxv, p. 123, 1910	Male 27. Anuria for 6 days. Cystoscopy revealed absence of right ureteral orifice. Opposite (left) orifice normal	Left ureteral catheterization relieved anuria. Recurrence of anuria on eleventh day relieved by nephrotomy	Death from bronchopneumonia 4 weeks later. At autopsy left (single) kidney found double the normal size. No right kidney. Small calculus completely obstructed left ureter.

TABLE II—Continued  
Cases of Congenital Single Kidney with Anuria.

No.	Reported by	Previous history and findings	Treatment	Results
7.	André..... Ann. mal. org. g. u., Jan. 1911, vol. xxix, p. 132	Male 42. Anuria of 48 hours duration. Left-sided colics for 6 yrs. Bladder empty on admission. Cystoscopy failed to reveal presence of right ureteral orifice. Negative X-ray	Anuria relieved by left ureteral catheterization	Recovery. Obstruction thought to be due to small impacted ureteral calculus.
8.	Tixier and Gautier..... Ann. mal. des. org. g. u., vol. xxix, p. 722, 1911	Female 20. Entered comatose after 4 days anuria with large left abdominal tumor. No urine found in bladder and none obtained on catheterization of right ureter	Drainage of hydronephrotic left kidney. All urine at first through fistula, later some per urethram	Recovery but prognosis considered very bad.
9.	P. Bazy..... Jour. d'Urologie, vol. ii, p. 645, 1912	Male 71. Anuria of 7 days duration, preceded by left lumbar pain. Emesis since onset. X-ray shadow in pelvic portion of ureter	Ureterotomy but no calculus found	All urine passed through fistula none from bladder. Recovery.
10.	Gorach, quoted by..... Papin, Encycl. France. d' Urol., vol. iii, p. 253, 1914	No details given before treatment was given	Relieved three attacks of anuria by ureteral catheterization in case of congenital single kidney	Recovery.
11.	Suter..... Handbuch. d. Inn. Med., vol. iii, Part 2, 1743	Symptoms of calculous anuria of solitary kidney	Nephrotomy	Death. No mention of an autopsy.
12.	Castano..... Rivist. assoc. med. Argentina, vol. xxvii, p. 423, 1917	Male 50. History severe colics (left). Anuria for 20 hours before admission. No urine in bladder. Cystoscopy revealed absence of right ureteral orifice. Opposite (left) orifice gaping and swollen	Relieved anuria by left ureteral catheterization but obliged to perform pyelotomy when anuria recurred after withdrawal of catheter. No urine per urethram until pyelotomy healed. Later small calculus passed spontaneously	Recovery.



# CONGENITAL SOLITARY KIDNEY

13.	Briggs..... Urol. & Cutan. Rev., April, 1921, vol. xxv, p. 210	Anuria of 24 hours duration accom- panied by pains over right kidney, chills and fever. History of similar attack four weeks previously. Large shadow over right kidney area. Right ureteral orifice but no efflux on catheterization. No left orifice visible	Pyelotomy (right). Tubercles seen on surface of kidney	No urine passed after pyelotomy. Died on sixth day after opera- tion. Failed to find left kidney or ureter at autopsy. Only allowed to examine this side.
14.	Arnold Heymann..... Zeit. f. Urol. Chir., vol. ix, p. 193, 1923	Female 35. Anuria of five days dura- tion. No urine found in bladder. Cystoscopy revealed absence of in- ter-ureteric ligament and of left uret- eral orifice. No indigocarmine ex- creted from left side of bladder	Right ureteral catheterization re- lieved anuria. Believes obstruc- tion to have been antiospastic. Pyelography after operation re- vealed normal sized pelvis on right side	Recovery.
15.	Eisendrath and Wright.....	Male 49. Anuria 24 hours duration. Left-sided colics. Cystoscopy and use of indigocarmine during three ex- aminations failed to reveal presence of right ureteral orifice. Large left kidney shadow, none on right side. No calculus shadows	Anuria relieved by left ureteral catheterization. Recurrence of anuria after withdrawal of cath- eter. Ureterostomy. Cause of obstruction found to be stric- ture of pelvic portion of left ureter	Recovery.
16.	Key..... Nord. med. Arkiv, vol. xli, p. 1, 1921	Sudden onset of anuria. Only right ureteral orifice present	Anuria relieved by nephrotomy. Ureteral calculus removed later, followed by fistula (renal) from which urine suddenly ceased to escape	Death due to pyelonephritis of solitary kidney complicated by stricture of the ureter.

TABLE III.  
*Cases of Congenital Single Kidney in which Nephrectomy was Performed.*

No.	Reported by	Pre-operative findings	Treatment	Results
1.	Guinard..... Arch. gen. chir. ?, p. 315, 1911	Symptoms of severe renal infection with calculi	Nephrectomy	Autopsy revealed the absence of opposite kidney and of the cor- responding internal genitalia.
2.	Polk, quoted by Schultz.....	Female 19. Large tumor in left iliac fossa	Removal of tumor (left single kidney)	Death eleven days after operation. Autopsy revealed absence of in- ternal genitalia and of right kidney.
3.	Schetelig, quoted by Winter.	No details given	Nephrectomy of single (congeni- tal) kidney	Death.
4.	Buss..... Zeit. i. Klin. Med., vol. xxxviii, p. 439, 1899	Left-sided tumor in true pelvis thought to be enlarged ovary	Removal of tumor which proved to be a kidney	Death seven days after opera- tion. No right kidney or inter- nal genitalia found at autopsy.
5.	Winter..... Arch. f. Klin. Chir., vol. lxxix, p. 611, 1903	Male 21. Sudden onset. Large right abdominal tumor. No cystoscopy	Exploratory operation revealed large cystic kidney. Nephrec- tomy	Death five days after operation. Autopsy revealed a left ureter 8 cm. ending normally below but blindly above. Left kidney ab- sent.
6.	Guiteras..... St. Louis M. & S. J., vol. lxxxiv, p. 129, 1903	Male 21. Symptoms acute left renal infection. Diagnosis of renal tuber- culosis made	Removed left kidney containing multiple abscesses	Died eight days after operation. No right kidney found at au- topsy.

## PYLORECTOMY FOLLOWED BY KOCHER'S METHOD OF GASTRODUODENOSTOMY IN CERTAIN CASES OF CARCINOMA OF THE STOMACH

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THEODOR KOCHER, Professor of Surgery in the University of Bern, Switzerland, describes in his text-book on Operative Surgery, published in 1903, his method of anastomosing the duodenum to the posterior wall of the stomach after pylorectomy or partial gastrectomy. It is known in surgical literature as Kocher's method of gastrectomy, in contrast to Billroth I, Billroth II, and Polya's operation.

For reasons unknown to me this method is rarely employed in this country or abroad, except in Kocher's Clinic.

Doctor Bloodgood's attention to this method was attracted when Dr. M. Hartwig sent him in 1900, a specimen resected in 1895. This specimen and its photograph are still in the Laboratory. On section it is a distinct carcinoma well circumscribed. This patient lived in comfort and died seven years after operation of an abscess of the kidney. It is the first recorded five-year cure of cancer of the stomach in the Surgical Pathological Laboratory of the Johns Hopkins Hospital.

Not until 1910, did Doctor Bloodgood have the opportunity to apply this method of anastomosis after pylorectomy or partial gastrectomy, because the extent of the ulcer or cancer made the area of stomach removed, too large to permit the suture of the duodenum to the stomach without tension.

The first gastrectomy of the Kocher type was performed in St. Agnes' Hospital, in August, 1910, more than thirteen years ago. The tumor was a freely movable mass at the pylorus producing almost complete obstruction, and the patient was starving to death. The operation was performed under local anæsthesia. Microscopically, the tumor proved to be a carcinoma (Figs. 4 and 5). This patient, now aged sixty-eight, is free from recurrence and in good health.

After reading the original description of twenty-six operations of this type, all but four of which were performed by Doctor Bloodgood, I would describe the technic as follows:

The abdomen is opened under novocaine in the midline above the umbilicus. In many of the cases gas, gas-ether, or light ether were given for the deeper manipulations. The stomach, duodenum, pancreas, glands along the lesser and greater curvature are carefully palpated and inspected.

With rare exceptions the following has been the rule as to the indication for resection: If the palpable mass gives the impression that it can be resected

with a good margin without or very little injury to the pancreas, and for this reason offers the probability of a cure should it prove to be cancer, resection is undertaken. If adhesions to the pancreas, or liver, or too extensive involvement of glands clearly portray a local condition which, if malignant, would not be cured by resection, some form of gastro-enterostomy is performed.

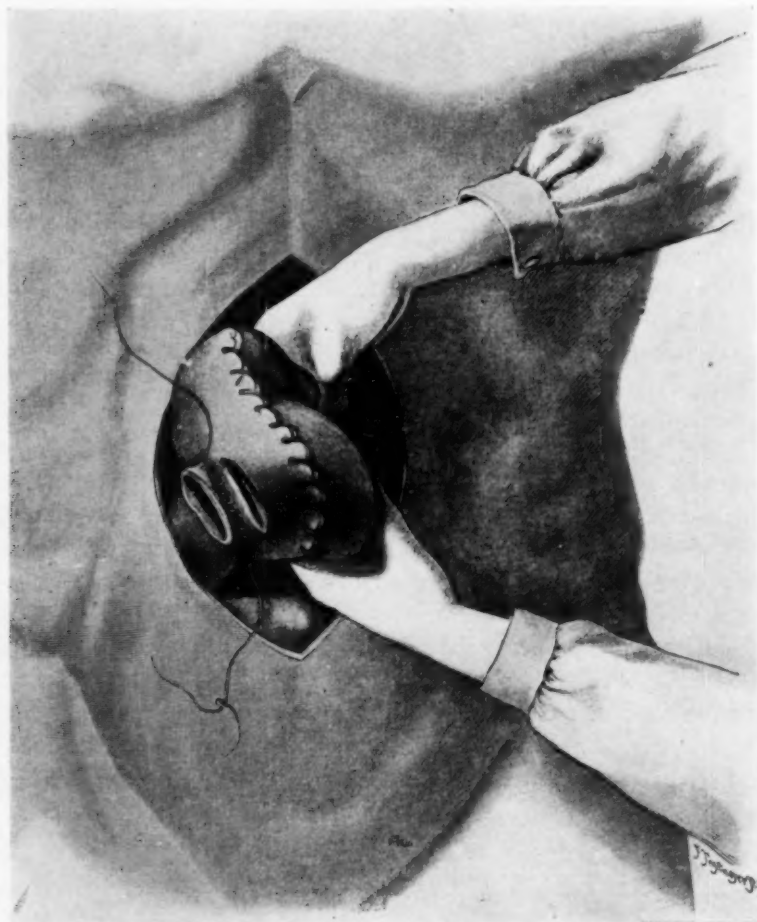


FIG. 1.—Kocher's method of anastomosis after pylorectomy. (From Kocher's book on Operative Surgery).

The experience that has been gained in these two clinics and in reading the literature has quickly shown that attempts at resection of local lesions, too extensive to offer a probability of a cure, when the lesion is malignant, simply increase the mortality of the operation and prevent permanent cures in extensive lesions which are benign ulcers.

This impresses me as the most practical view as to operative indications.

One cannot tell until resection is partially completed what the method of anastomosis will be. It has been Doctor Bloodgood's rule to choose

## PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

Kocher's method if the duodenum can be sutured to the posterior wall of the stomach without tension.

The first procedure is to find the point on the greater curvature of the stomach where resection will ultimately be made. The vessel along the greater curvature is divided between ligatures. Irrespective of whether

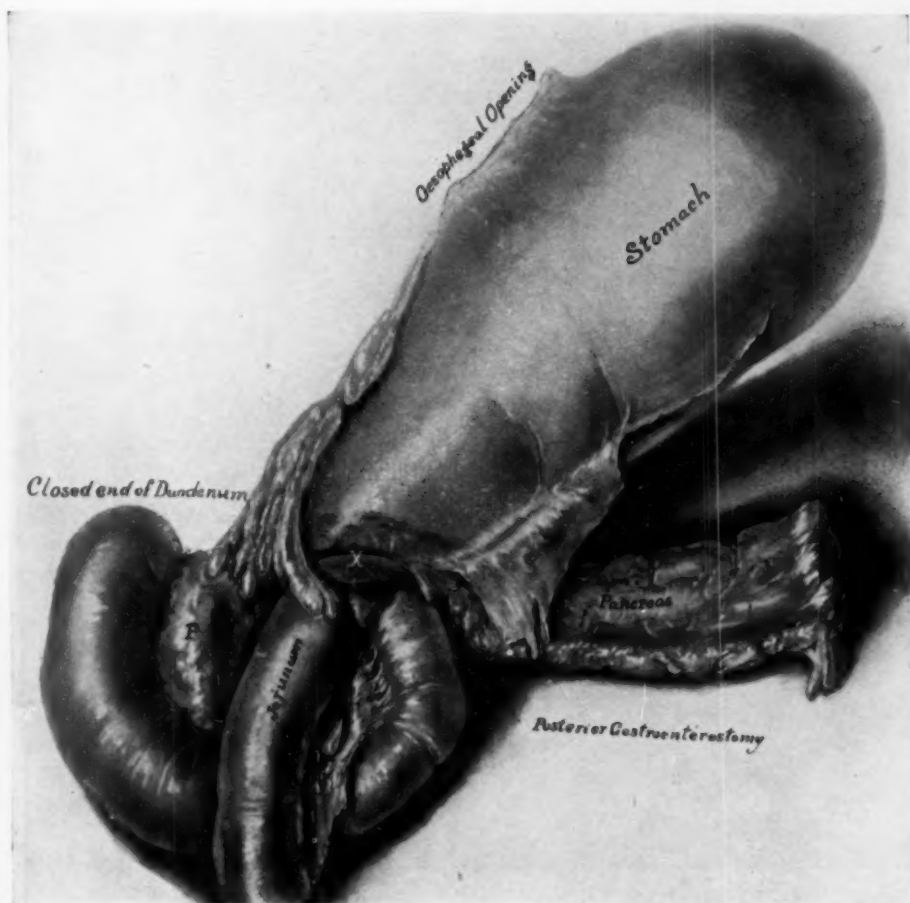


FIG. 2.—Photograph of autopsy specimen three months after pylorectomy for cancer with short-loop posterior gastro-enterostomy. (Billroth II.) Although it did not occur in this case, the illustration shows how a kink at "X" could produce acute dilatation of the duodenum. (Pathol. No. 9871).

glands can be seen or felt along the greater curvature, the gland-bearing area is left with the stomach, and the vessels in the omentum and the gastrocolic ligament are ligated at as great a distance as possible from the stomach without injury to the colon or the middle colic artery. The stomach is therefore freed from the colon and omentum, so that the operator can sweep his hand beneath the stomach and estimate the relations to the pancreas. Should this examination reveal adhesions more extensive than previously found, resection can be discontinued and some type of gastro-enterostomy performed.



The next most important step is to ligate the vessels on the duodenum and separate the stomach, pylorus and duodenum from the pancreas. The stomach is now separated except at its lesser curvature and the superior border of the duodenum. It is simpler to ligate the vessels on the upper



FIG. 3.—X-ray of stump immediately after bismuth meal of a patient whose stomach was resected with Kocher's anastomosis ten years before this X-ray was made. The anastomosis of the duodenum to the stomach is clearly shown. (Pathol. No. 12058).

border of the duodenum and pylorus, clamp the duodenum and pylorus, and divide with the knife or scissors, not with the cautery. The guarded clamp on the duodenum is placed lightly so as not to interfere with circulation. Often it is removed and a sponge placed over the opening of the duodenum. The stomach is now lifted outwards and downwards to the left, and the vessels of the lesser curvature ligated as far as possible from the stomach. *Having reached the point where the lesser curvature is to be divided, the remaining vessels and gland-bearing tis-*

*sue are separated from the lesser curvature of the stomach almost up to the diaphragm, just as one would remove the glands and tissue from the axillary vein. This never interferes with the circulation of the stomach, allows complete removal of the gland-bearing area on the lesser curvature side without removing uninvolved stomach wall.*

It is a well-known and fundamentally established fact that the smaller the portion of the cardiac end of the stomach left after resection, the greater the difficulty of anastomosis and the greater the likelihood of increased mortality.

The stomach having been freed, the operator tests whether the duodenum

## PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

can be sutured to the posterior wall without tension. If so, Kocher's method is chosen.

The anastomosis is a typical end-lateral. The method in this clinic is three rows of interrupted fine black silk sutures. The first row approximates the peritoneum of the duodenum to that of the stomach. Then the wall of the stomach is divided down to the mucous membrane and the second row introduced, catching the vessels in the stomach wall. The mucous membrane of the stomach is divided and sutured to that of the duodenum all the way around. There is no objection to using catgut in the mucous membrane,



FIG. 4.—Photograph of resected pylorus with portion of stomach and duodenum. Operation performed thirteen years ago. Patient well (1923). Anastomosis Kocher's type. For gross picture and photomicrograph see Figs. 5 and 6. (Pathol. No. 10763).

but in this clinic we have had no difficulty with the three rows of fine silk. The anastomosis completed, the stomach is divided without clamps and closed with three rows of fine silk. Now and then the suture is covered with omentum. Sometimes the transverse colon is fixed so it will not drop down. The abdominal wound is closed in the usual way.

*Post-operative Treatment.*—These patients are always given subcutaneous salt solution and salt per rectum until they are taking sufficient fluid by mouth. Gastric lavage is made the night of operation and the next morning, after washing out the stomach an ounce of castor oil is introduced. This gastric lavage should be continued as long as there are duodenal contents in the stomach, but rarely is it necessary after the first twenty-four hours when the Kocher anastomosis is made.

These patients are not given solid food for at least two weeks, nor are they allowed to swallow grapes, or the peel of baked apple. In an anastomosis

of this kind the lumen is partially closed by the necessary inversion and the inevitable inflammatory reaction. Solid food could easily obstruct, add to the discomfort, and might even be dangerous.

*Mortality.*—Among the 22 operations performed by Doctor Bloodgood, there are four deaths—a mortality of 18 per cent. The deaths occurred between 48 hours and 10 days, suggesting some type of embolism. There

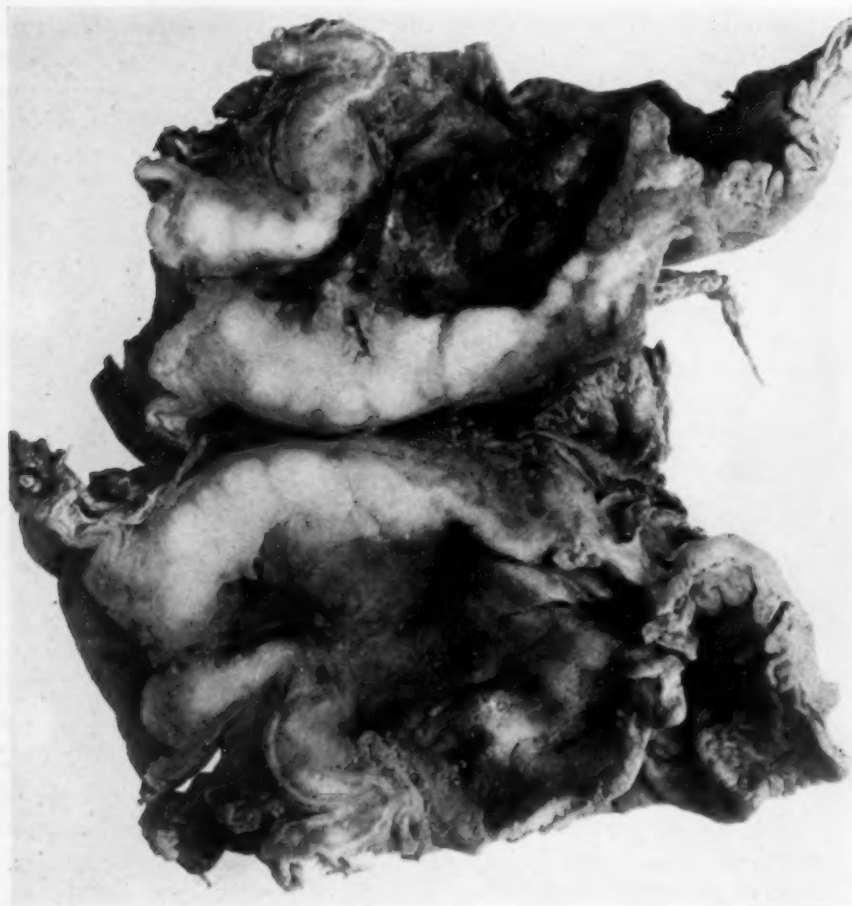


FIG. 5.—Photograph of opened stomach shown in Fig. 4. Note the white area of neoplastic growth infiltrating to, but not through, the duodenum and not through the peritoneum. Glands not involved. Well thirteen years after resection. (Pathol. No. 10763). For photomicrograph see Fig. 6.

was not a single example of peritonitis or other complications on part of the intestinal suture. Of the remaining 4 cases by three other operators there were two deaths, one of them from peritonitis. So that among the 26 operations by this method there is but one faulty suture.

The age and sex, and condition of this small group corresponded closely with that in the larger group of cancer and ulcer. They were neither better nor worse operative risks, but they were subjected to an operation of less extent than by any other method, except the Billroth I.

## PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

Of the 12 patients with carcinoma, 3 are living 13 years and 4 years, respectively, since operation, and one lived 7 years and died of other cause. Therefore, of the 8 cases with cancer in which it is five years or more since operation, 3 patients, or 32 per cent., have passed the five-year period. But it is to be remembered that these carcinomas were of the most favorable type, and answered Kocher's rule, which was: "The great majority of his

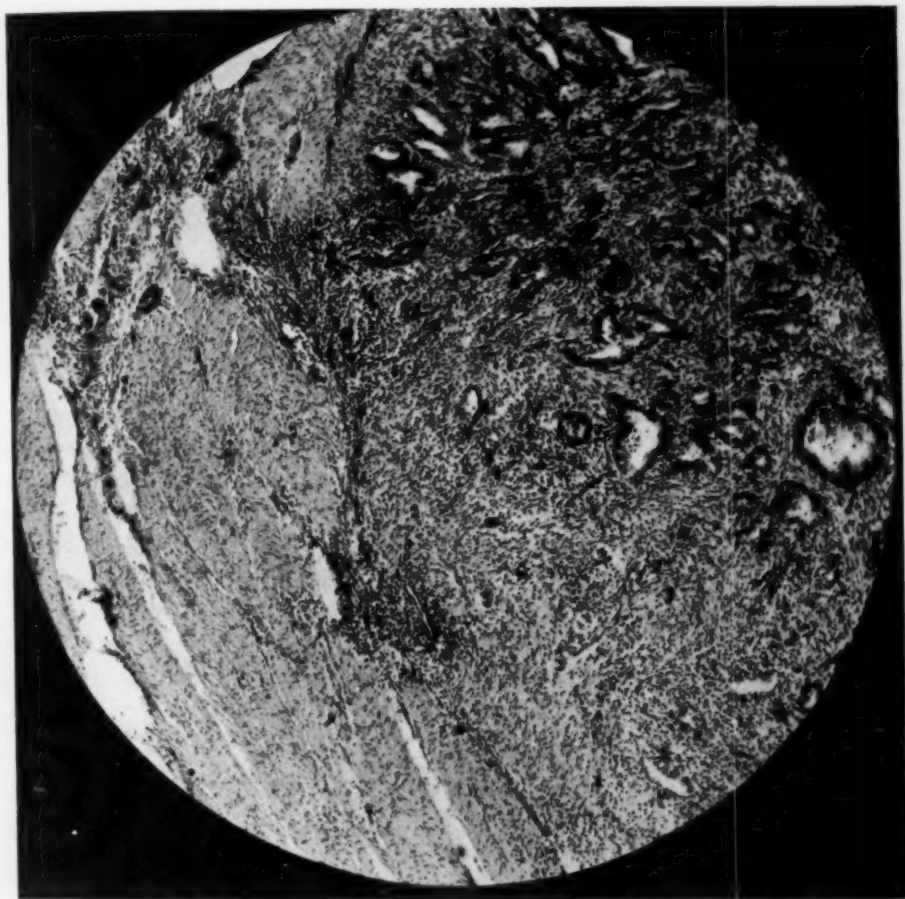


FIG. 6.—Photomicrograph (low power). Carcinoma from white neoplastic area shown in Fig. 5. (Pathol. No. 10763).

five-year cures of cancer of the stomach were freely movable nodules at the pylorus, producing early obstruction."

### REMARKS BY DOCTOR BLOODGOOD

Since 1900, at frequent intervals I have restudied the gastric material in the Surgical Pathological Laboratory of the Johns Hopkins Hospital. This includes the records of all the patients in the Surgical Service of Johns Hopkins and of St. Agnes' Hospital, and for many years from the Surgical

Service of the Union Protestant Hospital. We have carefully checked the immediate mortality and studied the ultimate function of the stomach.

The thing which impressed me most was that if the patient survived the operation the ultimate function of the stomach was about the same, irrespective

of the type of anastomosis or resection. It is important to remember that our gastric material as compared with some other clinics in this country and abroad is comparatively small, but I think it has been studied as carefully as in any clinic. I have taken X-rays and made fluoroscope examinations, had gastric analyses made, and recorded the digestive



FIG. 7.—X-ray before operation showing the filling defect due to a carcinoma at the pylorus. (Pathol. No. 32468). For gross specimen see Figs. 8 and 9.

functions of patients of the following groups more than ten years after operation: Billroth I, Billroth II, Kocher, Finney's pyloroplasty, different types of posterior gastro-enterostomy, anterior gastro-enterostomy and the long-loop Roux or "Y." No difference could be made out. The choice of the operation, therefore, does not depend upon the ultimate function, but upon the study of the immediate mortality and complications.

One must remember that the different types of resection of the stomach, or the different types of gastro-enterostomy are by no means always operations of choice—usually operations of necessity.



## PYLORECTOMY FOLLOWED BY GASTRODUODENOSTOMY

Our evidence indicates that the Kocher resection has the least mortality and post-operative complications. Finney's pyloroplasty in properly selected cases has practically no mortality and no complications. The short-loop posterior gastro-enterostomy for duodenal ulcer has practically no mortality and very few complications.

The chief objection to any resection of the stomach, followed by closure of the duodenal end and some form of gastro-enterostomy, is that a kink or obstruction, even temporary, in the gastro-enterostomy leads to acute dilatation of the duodenum and a toxic duodenal death brought out years ago in experiments on animals by <sup>X</sup> Draper and reported by me (*Journal Amer. Med. Assoc.*, July 13, 1912, vol. lix, p. 117).

In my early study of the literature I was impressed by the numerous deaths between the second and the fifth day attributed to shock with recorded autopsies <sup>Y</sup> noting no peritonitis. Later, from a case or two of my own I learned that these deaths were due to dilatation of the duodenum.

The danger of kinking of the gastro-enterostomy is apparently greater in a short-loop posterior, or the short-loop "Y," and distinctly less in any long-loop gastro-enterostomy. That the majority of the clinics in this country and abroad have substituted the Polya with a long loop is an indication that they were having trouble with the so-called Billroth II with a short-loop posterior gastro-enterostomy.

My limited experience teaches me that Finney's pyloroplasty is preferable to any form of gastro-enterostomy if it can be done and when it is indicated. That Kocher's anastomosis after gastrectomy is the operation of choice. When the gastrectomy leaves a defect prohibiting a safe Kocher, the gastro-enterostomy should be done with a long loop, and it makes very little difference whether it is of the Polya type or not. The point is that the loop must be sufficiently long to practically eliminate the danger of a kink and death from acute dilatation of the duodenum.

I rarely use clamps in anastomosis or resection of the stomach. I have



FIG. 8.—Photograph of the anterior surface of the portion of the stomach removed in the case shown in Fig. 7. (Pathol. No. 32468). Duodenum to the left; mass of glands and fat on greater curvature below; glands and fat on lesser curvature. The portion between Y and X has been dissected from the lesser curvature of that part of the stomach not removed. These glands are involved (see Fig. 9). (Pathol. No. 32468).

never had peritonitis from soiling. The fundamental principle of any anastomosis between hollow viscera is good circulation; second, perfect suture, and there is but one test of intestinal anastomosis—peritonitis from perforation in the line of suture, or obstruction. My experience teaches me that soiling is an exaggerated danger, and that circulation of the tissues and perfect approximation by suture are the essential features. I prefer Billroth's original



FIG. 9.—Longitudinal section through specimen shown in Fig. 8. Note the cancerous gland in that portion of the tissue removed from the lesser curvature shown in Fig. 8 between X and Y. Note the excavated ulcer surrounding the pylorus and breaking through the peritoneal coat above. Compare with the filling defect shown in the X-ray (Fig. 7). (Pathol. No. 32468) and compare with Fig. 5 in which the cancer has not broken through the peritoneal coat.

method of three rows of single sutures with the finest silk as adopted by Halsted, and not a single or double row of mattress suture. The continuous suture with catgut or linen thread has only one advantage—it is more rapid. As I have never tried it, I can neither praise nor condemn it. The operator's immediate mortality and the cause of death in the line of suture should indicate to him whether his method of suture is the best.

The recent contributions by William Mayo (*Surg., Gyn. and Obstet.*, April, 1923, vol. xxxvi, p. 447) and Richard K. Lewisohn (*ANNALS OF SURGERY*, October, 1923, vol. lxxviii, p. 507), indicate a tendency to return, if possible, to the Billroth I, the principle of which is identical with Kocher's. It has, however, an advantage that it might be accomplished without tension when the Kocher could not. The illustrations (Billroth I) in these two papers practically show the Kocher anastomosis and the trend

of modern surgery to return to the fundamental conceptions of gastrectomy as conceived by Billroth and Winiwarter, the Billroth I if possible, and if a Billroth II becomes an operation of necessity, then a long-loop gastro-enterostomy.

I have before me now Billroth's *Clinical Surgery* with his historical and epoch-making diagrams and illustrations, and years ago in my reviews in the *International Clinics* I have called attention to these principles.

I would suggest to my colleagues who may read this article to restudy their operative mortality in gastric surgery and estimate the element of faulty suture and acute dilatation of the duodenum.

## CARCINOMA OF THE DUODENUM

By DENVER M. VICKERS, M.D.

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FROM THE SURGICAL CLINIC OF THE MARY MCCLELLAN HOSPITAL

NEOPLASTIC disease of the small intestine is generally admitted to be rare, in contradistinction to carcinoma of the stomach and colon. Cancer of the stomach is rated by Osler<sup>1</sup> to be second only to that of the female genitalia, in point of frequency, quoting 30,000 autopsies by Welsh. Carcinoma of the rectum is not infrequent and carcinoma of the colon, especially around the flexures and the cæcum, while less often observed, is not unusual. But carcinoma of the small gut is still one of the rarities of medicine, either clinically or at autopsy.

Brill<sup>2</sup> estimated cancer of the intestine, excluding the stomach, as occurring in 2.5 per cent. of cancers found in hospital autopsies. Mayo<sup>3</sup> Clinic figures give 3 per cent.; Jefferson<sup>4</sup> estimates 3.1 per cent. and Geiser<sup>5</sup> 4 per cent. Forque and Chavin<sup>6</sup> in collecting and tabulating 88,031 autopsies, report cancer 6847 times, or 8.2 per cent.; of these 9.2 per cent., or 642, were intestinal; the large intestine being affected 613 times, or 94 per cent., of the intestinal cancers, and the small 39, or 6 per cent. Cancer of the small gut occurred, therefore in 0.5 per cent. of all cancers, or 0.04 per cent., of all autopsies. Other collected statistics from eight different authors<sup>6</sup> give 888 cancers of the intestine; of which 798 were in the large intestine, or 90.1 per cent., and 91, or 9.9 per cent., in the small intestine, with 42, or 4.5 per cent., in the duodenum; or in these cases 0.34 per cent. of all cancers occur in the duodenum.

For any given unit of length of small gut, the jejunum shows the greatest relative "immunity" to cancer. Aizner<sup>7</sup> reports one case and Murray<sup>8</sup> casually mentions another, but there are few others in the literature. Muller,<sup>9</sup> in 5621 autopsies, found cancer of the jejunum and ileum in only three cases compared to 6 in the duodenum. Carcinoma of the ileum near or at the ileocaecal valve brings up the total proportion for the jejunoileum slightly above that for the duodenum. McGuire and Cornish,<sup>10</sup> in 1920, tabulated 66 carcinoma of the duodenum from ten authors compared to 69 carcinoma of the jejunoileum, a ratio of 47.7 per cent. to 53.2 per cent.

The average length of the duodenum, according to Treves,<sup>11</sup> is ten inches; of the whole small intestine 22 feet 6 inches, so that for any given unit of length the susceptibility of the jejunum to cancer is decidedly less than that of stomach, colon or even duodenum.

The incidence of carcinoma of the duodenum or the relative frequency of that diagnosis in hospital autopsies is estimated at 0.05 per cent., or once in 2000, by McGuire and Cornish (nine authors, total of 151,201 cases),

who quote the eighteen cases of Fenwick,<sup>12</sup> found in 19,518 autopsies at the London Hospital, giving an incidence in itself of 0.09 per cent. Forque and Chavin's<sup>6</sup> more recent tabulation gives 0.034 per cent. It is to be recalled that these were all pathological reports rather than summaries of clinical material.

Of the duodenum itself, cancer is found most frequently in the middle portion, or peri-ampullary region. Fenwick gives 51 cases of which over half were in the second or descending, or peri-ampullary region. Geiser reports 71.8 per cent. and Rolleston<sup>13</sup> 67 per cent. of juxta-ampullary cancer. It is probable, however, that in a certain percentage of these cases the malignant

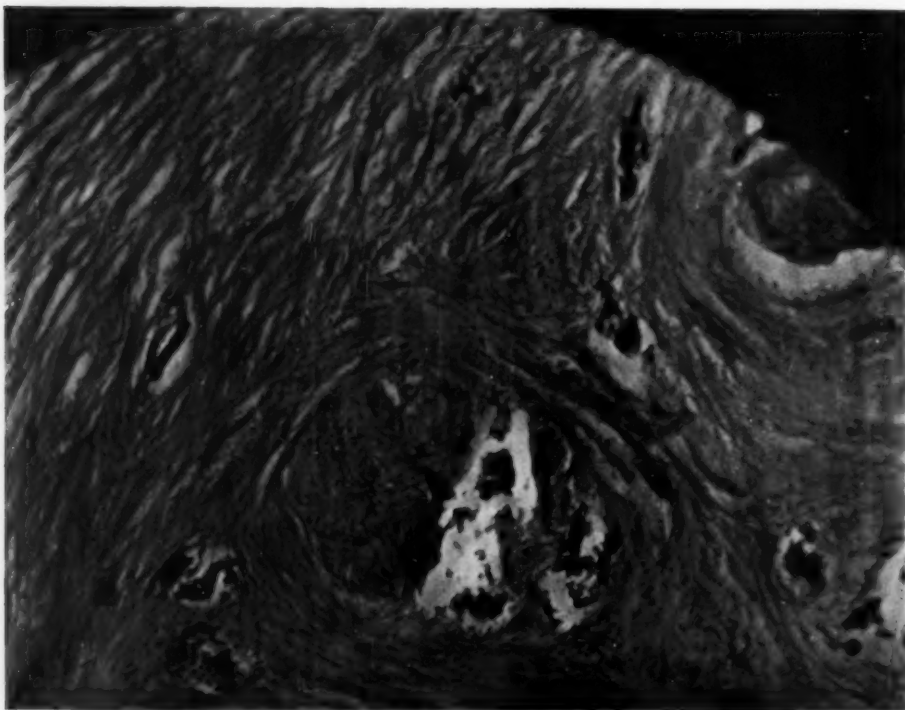


FIG. 1.—Microphotograph of section taken from the tumor found in the case reported.

growth arises in the common or pancreatic duct and only secondarily invaded the duodenum. The difficulty of exact diagnosis even at autopsy is obvious.

The incidence is next larger in the first portion and most uncommon in the third or juxtajejunal portion of the duodenum.

Mayo, in reporting three cases, found one in which the growth (in the first portion) seemed to be engrafted on a previously existing ulcer. Schrater, Ewald, Mackenzie, Leballe, and Letulle<sup>14</sup> have also reported similar cases. But while this might happen in new growths in the first portion, ulcerations are notoriously infrequent in the portion distal to the ampulla, so that the new growth following a preëxisting ulcer is decidedly unlikely. Lichy reports



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six cases of carcinoma of the first portion, none at the usual site for duodenal ulcer. Jefferson concludes that the relationship of duodenal cancer to ulcer "is difficult to establish."

Other factors give us no more clue as to the etiology of carcinoma in the duodenum than in new growths elsewhere. These patients are generally beyond middle age (fifty years, Pick) and the growth may follow irritation of the papilla by the change in reaction of the fluids, passage of gall-stones, etc., but no direct evidence is available. Why carcinoma is so frequent in the stomach and so rare in the duodenum, especially in the third portion, is one of the mysteries that may be cleared when we know more about the underlying causes of neoplasms.

Symptoms and signs due to duodenal malignancy vary markedly according to its location. Juxta-ampullary carcinoma makes known its presence mainly by obstruction to the flow of bile and pancreatic juice, with early jaundice, emaciation and death, and often cannot be differentiated from carcinoma of the head of the pancreas. Forgue and Chavin recognize the difficulty of accurate anatomical and pathological limitation of the ampulla, and classify the growth, whether intra- or peri-ampullary by the clinical picture, whether obstructive to the ducts or to the intestine, the "definition anatomo-clinique."

In cancer of the first or third portion, symptoms are of the digestive tract, anorexia, nausea and vomiting, constipation, diarrhoea and pain. In either supra- or infra-ampullary growths, the clinical picture may advance insidiously till it is difficult to distinguish from pyloric obstruction. In cases of infra-ampullary obstruction, the vomitus may contain bile and pancreatic ferments, which can be demonstrated by appropriate tests.

Physical examination in such cases reveals the dilated stomach, but rarely a palpable mass, as a growth large enough to obstruct, need not be large enough to be palpable through the abdominal wall. Metastases are usually late and small, and pelvic or rectal examination generally reveals no invasion of the "rectal shelf." Mayo<sup>16</sup> states that one-half of all cases of intestinal cancer show no lymphatic involvement at autopsy.

The prognosis is variable. Cases are described with symptoms from two days to two years. Hirschel<sup>18</sup> successfully resected the duodenum for ampullary cancer. Juxta-ampullary cancer is usually rapidly fatal and is an example of one area of the body, where a very small tumor can quickly produce extreme emaciation and death. Carcinoma above and below may go unrecognized till it produces almost total occlusion, with rapid change in symptomatology and clinical picture, with eventual death from starvation.

Treatment is, of course, primarily surgical. The technical difficulties offer great odds to the performance of any radical operation. Gastro-enterostomy may prolong life in the obstructive cases and relieve symptoms for considerable periods, as these tumors are slow growing and metastasize late. Cholecystenterostomy or gastrocholecystostomy have been performed for obstruction of the ampulla with varying success. The eventual outcome is obvious.



# DENVER M. VICKERS

CASE REPORT.—L. P. C., No. 16290, entered the hospital, April 8, 1923, complaining of vomiting. He was a married man of sixty-four, with no living children and no family history of cancer. He had always been well and active, and for the past few years had been doing hard physical work on a farm. He had had no trouble with the stomach till the onset of the present illness. One month before admission he began to vomit. This gradually increased till during the week before entry, he regurgitated practically everything taken by mouth, raising large quantities, even up to quarts or more, once or twice a day. He had had only slight epigastric distress and no acute pain. He had lost about twenty pounds in the past month and with the exception of the vomiting, feels perfectly well.

Examination showed an emaciated, poorly nourished farmer of sixty-four, who walked into the hospital. The general physical examination was negative. The abdomen was distended, but showed no involuntary muscle spasm. There was slight tenderness in the epigastrium and the stomach could be outlined by percussion as a huge sac, with the lower border almost to the iliac crest. Gastric lavage removed approximately a gallon of sour, foul, partly digested stomach contents. X-ray with barium by mouth, showed a huge, atonic stomach, with the barium obstructed just beyond the pylorus. The diagnosis of pyloric obstruction was made and operation advised.

Exploratory laparotomy by Dr. Chas. G. McMullen disclosed a huge stomach and dilated duodenum. The first and second portions of the duodenum were thin-walled, three times normal diameter, but showing no other abnormalities. Following along, a mass was palpated at the junction of the third portion of the duodenum with the jejunum. This mass was hard, indurated, fixed and clinically malignant. There were numerous small, pea-sized nodules scattered over the peritoneal surface of the intestine, the omentum and the colon. A quick posterior gastro-enterostomy was done and the incision closed. The radical operation was impossible.

For the first few weeks post-operative the patient did well. Soon, however, he began to vomit again, in spite of dietary restriction and frequent lavages. He began to go steadily down hill and finally after two months in the hospital he died.

Autopsy was obtained six hours post-mortem. The stomach was distended but not nearly to the extent seen at operation. In the third portion of the duodenum, where the duodenum turns about the ligament of Treitz and the superior mesenteric artery, there was a hard, firm, annular growth the size of a plum, adherent to the posterior abdominal wall. There were numerous small nodules, dotted over the peritoneal surfaces, about the size seen at operation. The primary mass was practically obstructing the lumen of the bowel, so that only a fine probe would pass. The growth had surrounded the superior mesenteric artery, so that the tumor removed for pathological study showed a section of the artery. The cut surface of the growth was hard, glistening and clinically cancer. Examination was otherwise essentially irrelevant, showing the changes characteristic of his age and nutrition.

Microscopical examination of the tumor mass showed much fibrous tissue, with rows or columns of epithelial cells, growing in acinous forms. The diagnosis of infiltrating carcinoma was confirmed by Doctor Ewing.

TABLE A

## *Carcinoma of Duodenum—Incidence*

Author	Total autopsies	Incidence %
Perry-Shaw, <sup>17</sup> Guy's Hospital .....	17,652	0.050
Fenwick, <sup>18</sup> London Hospital .....	19,518	0.090
McGuire, <sup>19</sup> quoting nine authors .....	151,201	0.033

# CARCINOMA OF THE DUODENUM

TABLE B

## *Carcinoma of Duodenum—Distribution*

Author	Portion			
	1st %	2nd %	3d %	Diffuse %
Fenwick <sup>12</sup> .....	21	57	13	8
Geiser <sup>5</sup> .....	15.5	71.8	12.7	
Rolleston <sup>13</sup> .....	24	67	9	
Deaver <sup>17</sup> .....	22.15	65.82	12.02	

## SUMMARY

Carcinoma of the duodenum is clinically unusual and is found in 0.033 per cent. to 0.09 per cent. of hospital autopsies.

Carcinoma is most frequent in the second, descending or periampullary portion. Next in order of frequency is the first portion, and last is the third or juxta-jejunal portion.

There are no significant facts in its site, age, distribution, preceding symptomatology to suggest an etiology, other than those of neoplasms elsewhere.

Symptoms follow from obstruction of the ducts in peri-ampullary cancer and from obstruction of the lumen of the gut in the infra- or supra-ampullary growths.

Treatment is primarily surgical and usually only palliative. Results in general are still unsatisfactory.

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## CHRONIC PRIMARY INTUSSUSCEPTION IN YOUNG CHILDREN

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ACUTE intussusception of the bowel is a disease of infancy and early childhood, chronic intussusception of adult life. The acute form of intussusception is usually of the primary type and the chronic form of the secondary type, or that in which the invagination is due to intestinal tumors, and so forth. The two children with chronic primary intussusception whose histories are presented in this paper were operated on at the Mayo Clinic by Doctor Judd, to whom I am indebted for the privilege of making this report.

Many cases of acute primary intussusception in young children, and chronic primary intussusception in adults have been reported in the literature, but of the chronic primary form in young children very little has been written. This is due not only to the rarity of the disease, but also to the fact that it is easily overlooked. Compared with acute invagination, the symptoms are much less striking; the child, who may simply appear to be unusually fretful, is not acutely ill, and so the condition is apt to be considered a slight intestinal disorder. While the symptoms, being obscure and indefinite, may suggest a wide field for diagnosis, there are certain features which are quite characteristic.

Wilms defines acute and chronic forms of intestinal intussusception as follows: 1. Very acute cases, death resulting in one or two days. (2) Acute cases, death resulting in from two to seven days. 3. Subacute cases, of one or two weeks' duration. 4. Chronic cases lasting two weeks or longer.

Other writers consider as subacute cases those in which the symptoms are of from one to four weeks in duration, and all cases in which the symptoms are of more than four weeks' duration as chronic. The division between the subacute and chronic cases is necessarily arbitrary.

There is a difference of opinion among writers with regard to the classification of the different types of intussusception. Probably the one most generally used is the following:

1. Ileo-iliac, or enteric type. One portion of small bowel becomes invaginated into another portion of small bowel.

2. Ileocaecal type. In the majority of cases, especially in children, the ileocaecal valve prolapses into the caecum. This becomes the apex of the intussusception, involving the ileum so that the caecum and colon form the outer and middle layers and the ileum forms the inner layer.

The ileocaecal type of intussusception is that which occasionally involves long tracts of the intestine. The ileocaecal valve may advance through the whole length of the large bowel and appear at the anus, or it may even

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protrude through the sphincter ani. In all cases, however, the ileocaecal valve remains the apex of the invagination.

3. Ileocolic type. In this form the lowest portion of the ileum prolapses through the ileocaecal valve into the colon, so that the ileocaecal valve itself and the caecum remain in their normal positions. The apex of the invagination is always formed by that portion of the ileum that first became prolapsed.

4. Colic type. One portion of large bowel becomes invaginated into another portion of large bowel.

Both of the cases reported here were of the ileocaecal variety. Weiss found that in 321 cases of intussusception, regardless of duration, invagination occurred as indicated in the Table.

TYPES OF INTUSSUSCEPTION

	Iliac Per cent.	Ileocaecal Per cent.	Ileocolic Per cent.	Colic Per cent.
Infants .....	24	42	10	24
Children .....	23	43	14	26
Adults .....	29.5	34.5	4.5	27

Lichtenstein, in 479 cases, irrespective of age or duration, found 52 per cent. of the ileocaecal variety. Goodall in a series of cases of chronic primary intussusception in adults showed 70.3 per cent. of the ileocaecal variety, 15.3 per cent. enteric, and 13.5 per cent. colic. However, he groups the ileocaecal and ileocolic cases under the same heading. Multiple invaginations, while very common in acute cases, are extremely rare in chronic cases, and are usually seen in the enteric variety.

The direction of the invagination is almost invariably descending; only a very few cases are to be found on record in which a retrograde invagination was present. Lichtenstein, who has compiled exhaustive statistics, found in a study of 500 cases of pathologic invagination of the bowel only eight of the ascending type.

*Pathology.*—In chronic intussusception, œdema, necrosis, and gangrene, which are characteristic of acute cases, although not the rule, are not infrequently seen. The peritoneal attachments usually have time to stretch, and as a result, the pull of the mesentery is less marked and the contractions of the bowel less violent; consequently, there may be little or no circulatory disturbance.

Adhesions may or may not be present. In the cases reported here they were of slight consequence, causing very little interference with reduction. However, in many cases dense fibrous adhesions are found and reduction is possible only after they have been cut. In Legueu's patient, who lived one year, no adhesions were found at necropsy. Hypertrophy of the intestinal musculature is usually found proximal to the intussusception which may be followed by dilatation.

*Etiology.*—The etiology in cases of chronic intussusception does not differ from the etiology in the acute primary cases.

Koch and Oerum, in a statistical survey of their work, including 107 cases previously published by Hirschsprung, remark that the geographical distribution of intussusception shows certain peculiarities. It would appear from formerly reported experiences that the English-speaking countries are especially subject to the affection; far more, for instance, than Germany or France. In Denmark and Great Britain, castor oil possibly plays a part in producing intussusception by the strong or irregular peristalsis which it induces. In Denmark mothers often use this drug indiscriminately of their own accord. It can scarcely be a mere chance that Denmark and Britain, the two countries where the greatest use and perhaps abuse of laxatives is made, should furnish the largest contributions to the statistics of intussusception.

Koch and Oerum distinguish two phases in the formation of an intussusception: 1. A primary circular contraction of the intestine. 2. The overlapping of the intestine.

The first phase is brought about by some abnormal irritation. The second phase was formerly explained as being the consequence of a contraction of the longitudinal muscles, but it was pointed out that the commencement of the overlapping was already affected by the circular contraction of the intestine which increases in length by depositing itself in the non-contracted part by means of a collar-like turning which smoothly increases by peristaltic action.

This explanation holds good not only for intussusception of the large bowel, but also for the ileocæcal forms when there is a circular contraction of the ileocæcal valve or of a part of the cæcum. Experiments have shown that the cæcal turning must be the primary event of the formation of the ileocæcal intussusception. Clinically, this mode of origin has also been substantiated at early operation.

Corbett has been able to produce artificial intussusception to a small extent by occluding the mesenteric circulation of the bowel both direct and collateral. Intussusception did not occur when large segments were tied off, but resulted from the complete occlusion of the blood supply to the small segments. These findings are corroborated clinically by the fact that thromboses are sometimes found in connection with intussusception.

The occurrence of an ileocæcal invagination is possible only when the cæcum is "floating"; hence, invagination is rare in the presence of cancer of the cæcum which fixes the intestine to its surroundings. The floating cæcum is found in 42 per cent. of infants and only 17 per cent. of older children, according to Leriche and Cavaillon.

#### REPORT OF CASES

CASE 192658.—D. T., a boy, aged two and one-half years, was first examined April 20, 1917. The mother stated that ten weeks previously, after eating some cheese, the child began to have attacks of sharp, fleeting pains through his abdomen, lasting a few seconds. During the attacks he cried, held onto his abdomen, and refused to allow it to be touched. The attacks persisted from four to twelve times a day, and in the intervals he was apparently free from pain. The boy had three vomiting spells lasting two or three days; but it was definitely stated that the



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vomiting was not associated with the pain. The bowels had been constipated since the onset of the trouble, but previously they had been regular. There had been no diarrhoea, but considerable mucus was passed at times with occasional traces of blood. The mother had noticed a great deal of gurgling in the child's abdomen, especially during attacks. There was marked loss in weight.

On physical examination the child was found to be fairly well nourished and weighed 22.5 pounds. There were a few palpable cervical glands, and the heart and lungs were normal. No mass could be felt in the abdomen, as deep palpation was prevented by muscular rigidity due to crying. The abdomen apparently was not tender. Rectal examination was negative. The temperature was 98.8 and the erythrocytes numbered 12,800. Examination of the urine showed quantity 100 c.c., specific gravity 1.019, reaction acid, and the slightest possible trace of albumin. The microscopic examination was negative. The stool contained no ova or parasites. A Röntgen-ray examination of the colon was attempted, but the patient could not retain the bismuth enema. A diagnosis was made of intestinal obstruction.

At operation a primary ileocaecal intussusception was found. The ileum extended into the caecum for several inches, and both the caecum and appendix were markedly thickened. There was some obstruction in the ileum. A lateral anastomosis was made between the distended ileum and ascending colon. The appendix was removed. The patient recovered.

CASE 194833.—L. B., a boy, aged three years, was first examined May 22, 1917. For ten weeks previous to examination he had had attacks of abdominal cramps lasting a few seconds and occurring about every five minutes, day and night. He cried out during the attacks which were aggravated by eating. There was no abdominal tenderness. The bowels had always been regular previous to the onset of the disease, but since then an evacuation had not occurred without the aid of cathartics. For five months previous to the appearance of these symptoms the child had been having vomiting spells, but there had been no vomiting during the illness itself. There had been a great deal of rumbling and gurgling in the bowels, usually after the attacks of pain. Neither mucus nor blood had been noticed in the stools.

Physical examination revealed a well-nourished child weighing 28.5 pounds. The cervical, axillary, and inguinal glands were palpable. No mass was palpable in the abdomen. Rectal examination was negative as was a röntgenogram of the colon. The temperature was 98.8 and pulse 108. The haemoglobin reading was 78 per cent. and the erythrocytes numbered 15,400. Examination of the urine was negative. Diagnosis was made of chronic intussusception.

Operation revealed a primary ileocaecal intussusception. The caecum and the appendix were prolapsed into the transverse colon, and both were greatly inflamed. The opening was dilated and the intussusception reduced. An appendectomy was performed with the excision of a piece of the mucous membrane of the caecum. The patient recovered.

*Symptoms. Chronicity.*—Chronic intussusception may develop after an acute attack has subsided or may occur as such from its incipency. Although the initial symptoms as a rule appear suddenly, such an onset does not necessarily indicate an acute course. On the other hand, the symptoms may develop gradually.

Both of the cases observed at the Mayo Clinic were of ten weeks' duration. Cases in adults have been reported in which the attacks have occurred over a period of three or four years.

*Pain.*—Pain is the most prominent and distressing symptom. It occurs in paroxysms of abdominal cramps of varying severity and length. During the attack, which is of sudden onset, the child cries, doubles itself up, and often holds onto the abdomen. The pain ceases as suddenly as it begins, the child stops crying, and to all appearances is no worse for the attack.

In both of the cases reported the attacks lasted but a few seconds. In one it was definitely stated that the paroxysms occurred every five minutes and in the other from four to twelve times a day. In severe cases they may persist for several hours. The location of the pain is of little value and only serves to confuse the condition with appendicitis.

Vomiting is relatively less common in chronic than in acute cases. When it does occur as in one of these cases, it is usually at the onset and rarely during the course of the illness.

*Stool.*—The character of the bowel movements varies. The only thing that we can be certain about in regard to the evacuation of the bowels is its very uncertainty. The severity of the case has no relation to the condition of the stools.

In both cases the bowels had been normally regular, but had become constipated at the onset of the disease and remained so throughout its course. In adults, diarrhoea and constipation are of about equal frequency. Constipation is the usual condition found in enteric invaginations.

Blood and mucus, if present in the stools, are of material aid in the diagnosis. They occurred in only one of these cases. In chronic cases blood in the stools does not play the important part that it does in acute cases, in which it is of very frequent occurrence. Fraser states that a case which possesses the characteristic features of intussusception and yet shows no blood in the stools is almost entirely enteric in type. It might better be said that an enteric invagination rarely shows blood in the stools, because in many cases of ileocaecal intussusception blood is not seen. Occasionally intussusception occurring above the ileocaecal valve will produce blood in the stool.

Rumbling and gurgling are frequently present in all varieties of intestinal obstruction which occur usually either during or, as is more often the case, with the cessation of the colic.

*Physical Signs.*—In chronic intussusception in children tenderness is not marked and may be absent. Distention is another symptom which is quite variable but is rarely very pronounced.

*Tumor.*—In all forms of intussusception the presence of an abdominal tumor with its variations in size, position and consistency, either during or independent of an attack of colic, is very characteristic, but cannot always be palpated. Tumor is not always present, especially in the chronic type occurring in children. In both of the Clinic cases we were unable to detect a tumor. Still has shown that the muscular rigidity produced by crying when palpation is attempted can be obviated by examining the child during sleep. Chronic intussusception is frequently mistaken for tuberculous peritonitis. The transverse tumor associated with wasting simulates tuberculous peritonitis

## CHRONIC PRIMARY INTUSSUSCEPTION IN YOUNG CHILDREN

with its mass of thickened, caseous omentum. The onset is more gradual. An unnatural emptiness in the right iliac fossa often helps to differentiate tuberculous peritonitis.

*Gaping Anus.*—Broca, Moizard and Gandeau have called attention to the gaping of the anus in cases of chronic intussusception, and the symptoms led these authors to the proper recognition of two cases. They mention that this finding is never present in inflammation of the sigmoid flexure, in chronic intestinal catarrh, or in the course of a low grade of peritonitis. These symptoms have never been noted in our experience.

*Röntgen-ray Examination.*—In one of our cases the patient was unable to retain the barium enema; in the other the X-ray of the colon was negative, and of no assistance. One should hesitate to place too great reliance on a röntgenogram of the colon in suspected cases.

### SUMMARY

Chronic primary intussusception in young children is relatively uncommon.

The clinical and operative histories of two children operated on at the Mayo Clinic are recorded.

The symptoms may be vague and misleading, but careful investigation into the past history, and observation of the child during an attack, will often suggest the true condition.

Intermittent attacks of abdominal pain of sudden onset, occurring over a period of weeks or months, of short duration, and disappearing suddenly with complete relief, are characteristic.

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## FASCIA TO FASCIA IN INGUINAL HERNIA OPERATIONS

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STUDIES of Major Seelig, St. Louis, Mo. (Transactions American Surgical Association, 1923) have recently drawn attention to the fact that muscle tissue does not unite to fascia when these two structures are coapted by suture in the sense that fascia unites to fascia. His experiments developed the observation that when muscle masses are united to white fascia, actual union occurs only between the white fascia and the connective-tissue elements forming the septa between bundles of the red muscle tissue.

Although instances in which at secondary operation an apparently firm union between red muscle and white fascia has been noted, these observations are hardly to be regarded as conflicting with the conclusions of Seelig, noted above, since, for example, the permanent attachment of Poupart's ligament to the red muscle of the internal oblique following suture may well occur through union of the connective-tissue elements of the muscle structures on the one hand and the white fascia of the ligament on the other.

These findings lend some encouragement to those who are accustomed to draw the conjoined tendon with the *falx inguinale* to Poupart's ligament over the cord with a view to strengthening the lower portion of the roof of the canal in operations for inguinal hernia, for here, connective-tissue elements are united to connective-tissue elements only. Fascia, it has been shown by Arthur Ayer Law and others, will unite to fascia under considerable tension. This, all surgeons have been able to prove clinically by noting success after operations in which it had been necessary to apply tension to bring the conjoined tendon to Poupart's ligament.

If it is true that tension does not interfere seriously with the union of these two connective-tissue structures, the fact can be utilized in those types of wide inguinal hernia in which owing to a relaxed condition of the conjoined tendon often associated with this pathology, the conjoined tendon can be drawn to Poupart's ligament at a level sufficiently low to reinforce the external ring. That is, this can be done if the fear of uniting these two structures under some tension be abandoned. Thus the transplantation of the rectus muscle as advocated by Bloodgood and the turning over of a flap of the anterior sheath of the rectus muscle as practised by Woelfler & Halstead, procedures requiring considerable time and art for their performance, may be less frequently resorted to if the firm edge of the conjoined tendon can be successfully drawn and held to the under surface of the even more firm fabric of Poupart's ligament.

The writer has in a few cases of wide hernia, utilized the plan of Bloodgood incising the sheath and suturing the belly of the rectus muscle to Poupart's ligament but has felt that this dislocation of an important anatomic structure does



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not often suffice to overcome the difficulty present. Merely incising the sheath of the rectus and the conjoined tendon to relax tension upon the sutures placed in the margin of the internal oblique and conjoined tendon is of course conservative and often helpful.

A difficulty encountered not infrequently in attempting to draw the conjoined tendon to a point low on Poupart's ligament, in order that the aperture of exit of the cord may be small enough, is due to the circumstance that the direction of fascia fibres in the conjoined tendon is such that ordinarily sutures passed successively through the edge of the conjoined

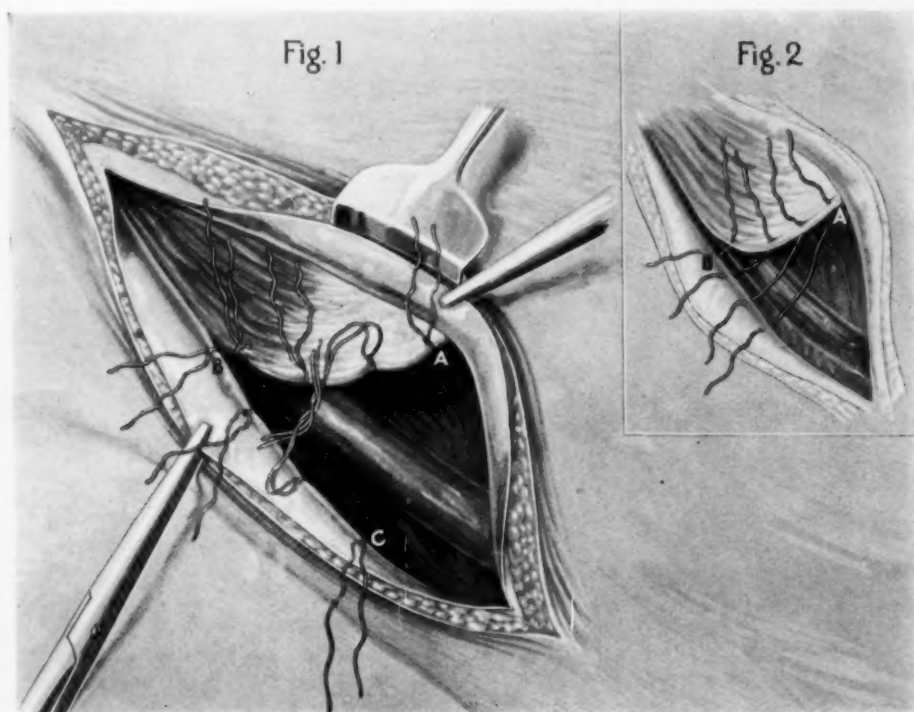


FIG. 1.—Sutures fixed by hard knot do not split the conjoined tendon and make it possible to bring A to C by tying long double strands of knotted sutures.

FIG. 2.—Sutures passed thus through edge of conjoined tendon, tend to split fibres when under tension bunching at B leaving defect wide open.

tendon, have a tendency to produce a splitting off of the edge of the structure and a sliding of the end of suture, which traverses the tendon in a direction upward and outward so that when attempts are made to draw over that portion of the conjoined tendon which is near the attachment to the pubic bone, the sutures split back, bunching, so to speak, at point too high on the margin of the conjoined tendon to admit of a snug closure of the ring.

Binnie suggests that this trouble may be, to some extent, obviated by taking care not to grasp with the needle the same longitudinal fibres each time.

A very simple expedient is of great help in overcoming this difficulty, It may be well known to many surgeons but because it has not been set forth in



the literature of the subject, in so far as it has been possible to discover, it is presented here for whatever it may be worth. It consists in passing a long, number one chromic catgut suture through the edge of the conjoined tendon and another such suture through the under surface of Poupart's ligament. These long sutures are tied in a hard knot at their middle so that they cannot split and slide. The long double strands are then tied together as shown in Fig. 1. This plan of suturing makes it possible to unite a given point on the

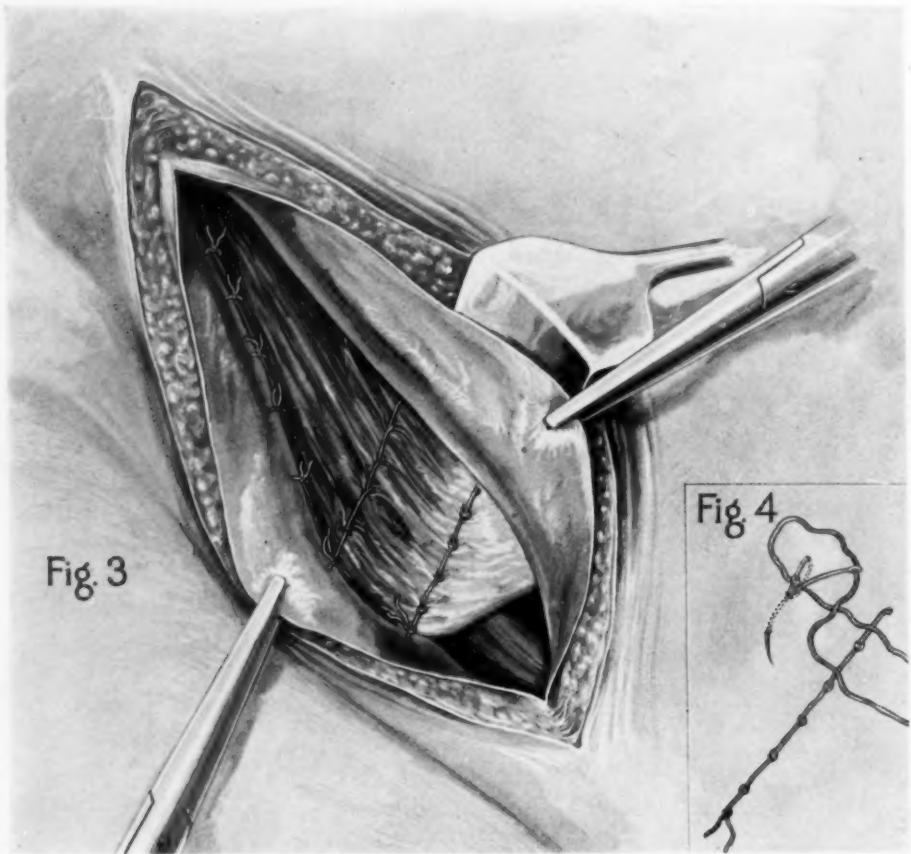


FIG. 3.—Running knotted loop sutures woven into internal oblique and conjoined tendon holding them firmly to Poupart's ligament.

FIG. 4.—Diagram illustrating method of introducing knotted loop sutures.

conjoined tendon to a given point on the under surface of Poupart's ligament which two points might be impossible of approximation with ordinary suturing, owing to the tendency to split back mentioned above. Mattress sutures and button sutures can hardly be made so effective as the knotted suture.

A running knotted loop suture, Fig. 3, may be used to provide additional security in holding the conjoined tendon firmly in a desired relation to Poupart's ligament. This knotted loop suture quilts together the fibres of the conjoined tendon or the muscle bundles of the external oblique and transversalis, so

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that the integrity of these structures is preserved when traction is applied to their arching border. Such a suture will not cut out unless the pull be very great indeed, for the tension is distributed between or divided among many points instead of one as in the case of the ordinary suture. In the case of wide herniae, one or two such running knotted loop sutures may be used to reinforce the interrupted or continuous coaptation sutures such as are ordinarily employed.

The manner of introducing the running knotted loop suture shown in Fig. 4 is as follows: Beginning at the edge of the rectus sheath, the curved needle is passed into the conjoined tendon or the red muscle of the internal oblique and transversalis, as the case may be, and the point of the needle brought out about two-thirds of a centimetre nearer the arching border than it entered. The long suture is drawn through to a point near its middle and tied with a reef or hard knot as if one were tying off a blood-vessel, the knot falling over the aperture of exit or the opening nearer the arching border of the conjoined tendon. The needle is then passed back through the hole, under the knot for the second loop and the long ends are tied again over the opening at which the needle emerges. The last loop, of several thus introduced, embraces the edge of the conjoined tendon or the margin of the red muscle if applied higher up. Great traction may be applied to such a suture without tearing the tissues into which it has been woven. Simply passing one strand of the strong chromic catgut suture through the under surface of the notably firm Poupart's ligament completes a tension suture in which unusual confidence may be reposed. It is believed that employment of such a plan of suturing may make possible more extensive coaptation of fascia to fascia, which, in view of the recent studies mentioned above, is a matter of importance in establishing complete and firm closure.

## HISTOLOGIC EVIDENCES OF INFLAMMATION IN THE SACS OF CERTAIN INGUINAL HERNIÆ\*

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EARLY anatomists called attention to the various layers of fascia and muscle covering hernial protrusions, explaining thereby the origin and nature of these structures. This knowledge gave anatomical guidance in the dissection of inguinal region, in the freeing of the sac and dealing with its contents.



FIG. 1.—Fibrous hernial sac. Section of wall of sac, showing usual structural arrangement in an adult with hernia of two months' duration. (Low power.)

In more recent times based on autopsy and operative material, further knowledge has been added so that besides acute changes associated with incarceration and strangulation, a series of secondary pathologic changes which may occur in the chronic hernial sac are recognized. The hernial sac may become thickened with what is commonly regarded as a chronic inflammation, particularly when the intestine or omentum has been a part of its contents or when a truss has been worn.

Under these circumstances, adhesions between the sac and the contained intestine or omentum may be formed and irregular areas of obliteration of the sac have been described. The difficulty of freeing the sac from adjacent structures has given rise to the impression that a fusion of greater or less extent takes place between the outer structures of the sac and neighboring fascia and muscle. These

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various fibrous changes are described by Kaufmann<sup>1</sup> and Choyce<sup>2</sup> and descriptive names have been applied to the special conditions encountered.

Very little attention has been paid to the histopathology of the hernial sac and only an occasional reference is found, such as by Murray.<sup>3, 4</sup> The extirpated sac has not been subjected to a routine histological examination as is the case with other tissues removed at operation. The present paper deals with observations made on the histopathology of hernial sacs removed at operation and discusses various inflammatory reactions found. It is based on 250 cases of inguinal hernia, the material being drawn from various

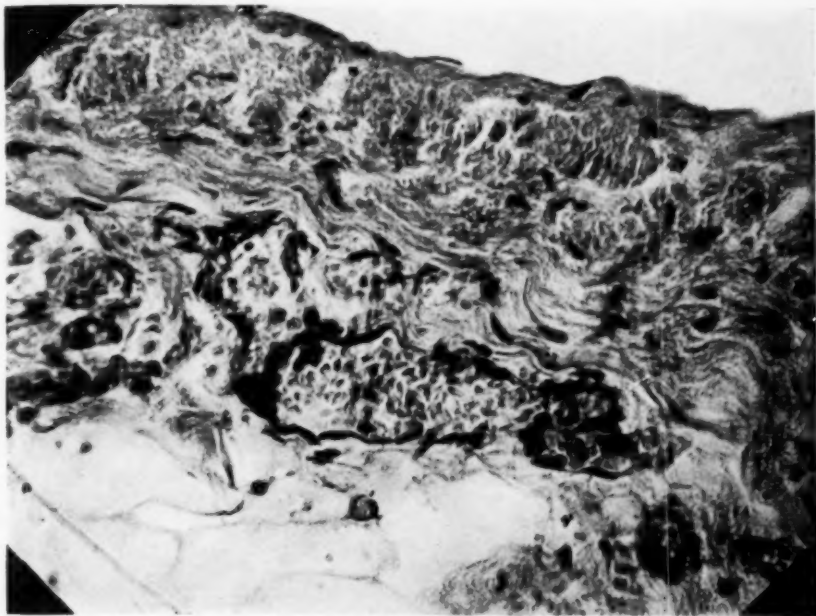


FIG. 2.—Fibrous hernial sac, showing arrangement of subendothelial connective-tissue in three layers; a superficial and a deep layer lying parallel, and a middle layer at right angles to the other two. (High power.)

sources; but in large part from herniæ occurring in individuals employed in brass mills who work under conditions of severe manual labor.

The peritoneum of the internal ring of the infant at birth and also that of adults consists of a single layer of endothelium, resting on delicate connective-tissue with an intermingling of elastic fibres. There is often a thickening of mild degree of the supporting connective-tissue, at the point of the internal ring where it admits the cord, with a well-defined pad of fatty tissue lying below the fibrous tissue elements.

A microscopic study of both the indirect and direct forms of inguinal hernial sac shows that these fall morphologically in either case into two groups. The first group may be called the fibrous hernial sac (Fig. 1) and is characterized by a dense fibrous sub-endothelial layer. The fibrous tissue lies directly beneath the endothelium and supports the fine capillaries of

arteries, veins and lymphatics which course upward toward the endothelium from a vascular and lymphatic plexus lying in contact with the deeper parts of this connective-tissue zone. The subendothelial connective-tissue in some sections appears to be arranged in three distinct layers, a superficial and a deep layer lying parallel and a middle layer at right angles to the other

two (Fig. 2). Externally the fibrous tissue layer lies in contact with structures such as muscle, fascia or the tissues forming the cord. Elastic tissue fibres are arranged in strong bands deep in the connective-tissue zone. They are conspicuous, as well, directly below the endothelium.

Fibrous hernial sacs have a tendency to become thickened in the progress of their development. They represent the more common form of hernial sac of adult life as well as that of infancy and childhood.

The second group may be designated as a fibrous-fatty hernial sac and is encountered particularly in direct



FIG. 3.—A fibrous hernial sac, showing typical inflammation of the subendothelial connective-tissue associated with onset of hernia after muscular effort. (Low power.)

hernias (Fig. 4). The subendothelial connective-tissue layer is delicate and relatively thin and rests upon fatty tissue. The fat in its turn externally lies in contact with neighboring muscle, fascia and structures of the cord. There may be an extensive invasion and replacement of subendothelial fibrous and elastic tissue by fat, so that nothing remains of the subendothelial connective-tissue zone but a fine line composed of fragmented hyaline strands supporting elongated and thinned endothelium (Fig. 5). Such advanced fat invasion associated with fibrous and elastic tissue atrophy, doubtless represents a regressive change in the peritoneum of the sac. It is seen in both direct and indirect forms of hernia. The process was found far advanced in the case of man twenty-four years old as early as three weeks after the onset of



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his hernia. This fact suggested that certain atrophic changes in the peritoneum of the inguinal region acted as a contributing factor in the production of this hernia.

Evidences of inflammation may occur in both types of hernial sac (Figs. 3 and 4) and the inflammatory reactions are noted chiefly in the subendothelial layer of the connective-tissue. This becomes swollen, broadened through an increase in connective-tissue cells and infiltrated with inflammatory cells. Except in very acute cases of incarceration or strangulation where polymorphonuclear leucocytes in large numbers invade the wall of the sac, the usual cells of inflammation are lymphocytes, mononuclear cells with a few polymorphonuclear leucocytes and eosinophil cells. Frequently these cells of inflammation are grouped about the smaller capillaries. At times the inflammation is seen only here and there in the sac, especially in small recesses formed by folds.

Small fresh hemorrhages are often found in inflammatory areas of the sac, attributable to trauma in handling of the sac at the time of its removal at operation. Of interest are the

occasional evidences of old brownish-colored pigment seen occupying the cell bodies of mononuclear leucocytes. This probably means that at some time previous to operation, minute hemorrhages occurred in the region of the inflammatory area of the sac, possibly associated with some form of trauma, and that blood pigments such as hemosiderin has been taken up by these phagocytic cells.

Hyaline changes in the connective-tissue are relatively frequent, and delicate connective-tissue fibres are transformed into bands of hyaline with

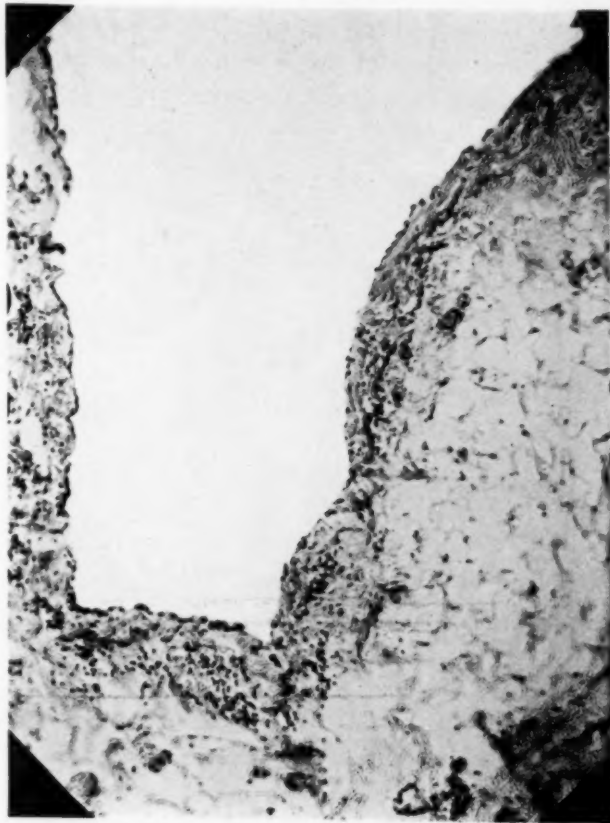


FIG. 4.—A fibrous-fatty hernial sac, showing mild inflammation of the connective-tissue below the endothelium. This type of hernial sac is characterized by a relatively small amount of subendothelial fibrous and elastic tissue which rests upon fat. (Low power.)

only occasional and scattered nuclei. Calcification, bone and cartilage formation described by Choyce as occurring in sacs of hernias were not observed in this series.

In the older fibrous hernias there was noted an invasion of adjacent muscular structures with fibrous tissue, so that muscle bundles are split up and often atrophied in appearance. It is this fibrous fusion of the connective-tissue of the peritoneal parts of the sac with adjacent structures which is commonly encountered at operation when the sac is freed with difficulty.

Of importance from the standpoint of inflammation are certain areas of fibrous thickening lying directly beneath the endothelium. These can be seen on gross inspection of the inner surface of the sac and appear as grayish elevations, patches, plaques, ridges or bands found either in the fundus of the

sac or near the neck in the region of the internal ring. Patches of this kind are composed of dense connective-tissue and are well supplied with blood-vessels penetrating from the deeper lying vessels in the direction of the endothelial surface. At times such plaques show evidence of active inflammation (Fig. 6), but often this is not present.

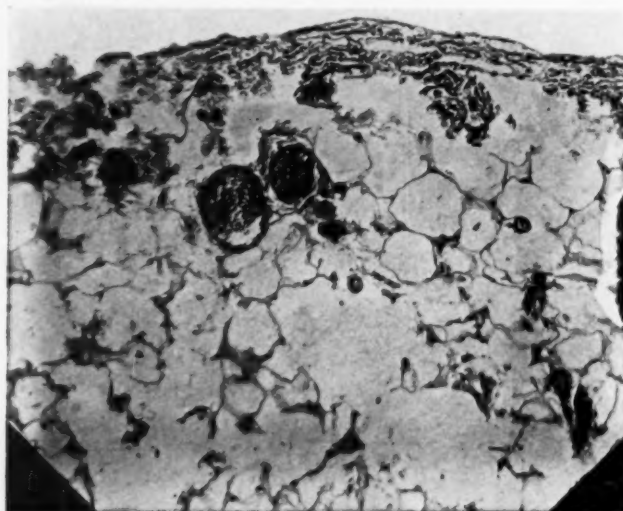


FIG. 5.—Fibrous-fatty hernial sac with extensive invasion of fibrous subendothelial tissue by fat, so that only a few hyaline strands of former fibrous and elastic tissue remain. (Low power.)

The simultaneous occurrence of

inflamed plaques with others which do not exhibit inflammation, can occasionally be distinguished in the same specimen. It is not unlikely that the plaques without signs of active inflammation represent a quiescent state following an earlier period of inflammation.

In the 250 specimens of hernial sac examined, thirty-seven showed evidences of active inflammation. It occurred under a variety of circumstances; in those who had not worn trusses and in those who had. The youngest patient was two years of age, while the oldest was seventy-two. At times there was an associated history of discomfort or pain; again, there were cases where the condition of inflammation was without clinical symptoms. In two cases, a very definite subacute inflammation preceded actual incarceration.

In one of the cases the inflammation of the sac was of tuberculous character (Fig. 7). This occurred in a man of thirty-five years who previously suffered from an active tuberculosis of the lung, but at the time of

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operation the pulmonary condition was in a quiescent state. Two months previously, following an unusual muscular effort while at work, he developed pain in the right groin and a small hernia. The tuberculous character of the sac was not recognized until a microscopic examination of the extirpated sac showed in areas of active inflammation a few minute tubercles containing giant cells lying directly below the endothelium.

In a second individual, a girl of twelve years, who twelve days before operation developed an inguinal hernia, an active inflammation of the sac was found with numerous giant cells of the foreign body type (Fig. 8).

In a third case, that of a woman thirty-two years old, who developed an incarceration in an inguinal hernia, several parasites resembling trichinæ



FIG. 6.—Fibrous hernial sac. A small fibrous plaque showing inflammation. (Low power.)

were found embedded in an actively inflamed subendothelial connective-tissue zone (Fig. 9).

It is the purpose, however, of the present paper to call attention particularly to the microscopic inflammation which occurs in a hernial sac soon after the development of hernia following muscular effort.

To illustrate this, brief extracts from histories of six cases are cited. The character of the inflammatory lesions are like those seen in Fig. 3:

CASE I.—V. S., male, age forty-two, factory worker. Two weeks ago while lifting a heavy load, developed severe pain in the right groin. This was not severe enough to keep him from working. Four days before admission noticed for the first time a small swelling in the right groin. At operation there were mild adhesions of the sac to adjacent tissue and a considerable amount of fat in the region of the cord. The sac was small, measuring about 3 cm., walls a little

thickened with some fat adherent to its outer surface. Microscopic examination shows a fibrous hernia with a marked inflammation consisting of lymphocytes, mononuclear cells, plasma cells and a few polymorphonuclears infiltrating the sub-endothelial connective-tissue which is thickened and rich in connective-tissue cells. The masses of inflammatory cells are grouped about the smaller capillaries, particularly in the deeper portions of the section.

CASE II.—F. B., male, thirty-three, laborer. Six days ago while at work he lifted some heavy weights and felt severe pain, developing a small swelling in the left groin. This swelling was not particularly tender. During the past few days it has become less marked. Examination showed no definite hernia but a ring admitting the tips of two fingers with a distinct impulse on coughing. On operation a small sac was found which showed no gross changes, but microscopically the following condition: Sections show a fibrous hernia with a very



FIG. 7.—Tuberculous inflammation of a hernial sac, in a patient with chronic pulmonary tuberculosis, who developed a painful hernia two months previous to operation. (Low power.)

noticeable infiltration of the subendothelial connective-tissue with lymphocytes, mononuclears and plasma cells (Fig. 3). The subendothelial connective-tissue is increased in amount and rich in nuclei. Some of the mononuclear cells contain old blood pigment.

CASE III.—M. M., female, age twenty-three, housework. One week ago following effort at lifting, felt marked pain in the right inguinal region without nausea or vomiting. This pain has been of varying intensity ever since then. She noticed at the time of the onset of pain a small almond-shaped mass in the groin. Operation disclosed an indirect hernia with a small sac without any gross changes. Microscopic examination shows a fatty hernia with the delicate fibrous tissue lying directly beneath the endothelium, infiltrated with a large number of lymphocytes, mononuclear cells and a few polymorphonuclears. Directly below the connective-tissue zone the sac is composed of fat, which shows no inflammation.



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CASE IV.—L. S., age forty-eight, male, laborer. Seven days ago thought he had a slight cold or gripe. This apparently did not confine him to bed and about this time he developed a pain in the right groin and over the region of McBurney's point. At the same time he noticed a small swelling in the right inguinal region, the size of a walnut. At operation there was found a small indirect hernia and an atrophied appendix, which was removed. Microscopic examination of the appendix showed chronic atrophic changes without inflammatory cells. Examination of the hernial sac showed the following condition: There is a thick fibrous hernial sac with a well-defined inflammation below the endothelial lining. Inflammatory cells consist chiefly of lymphocytes, a few mononuclear cells and plasma cells. The tissues external to the peritoneal lining of the sac are considerably thickened, but no inflammatory cells are found in this region.

CASE V.—Age forty-nine, male, brass worker. For the past week following heavy lifting, patient has noticed a small, slightly painful mass in the left inguinal region. Operative findings showed an indirect hernia and microscopic examination disclosed a fibrous type of hernial sac with here and there small thickened plaques. A section of one of these patches shows a very striking round-cell inflammation. Polymorphonuclear leucocytes are not present. There are considerable mononuclear cells, some containing brownish pigment.

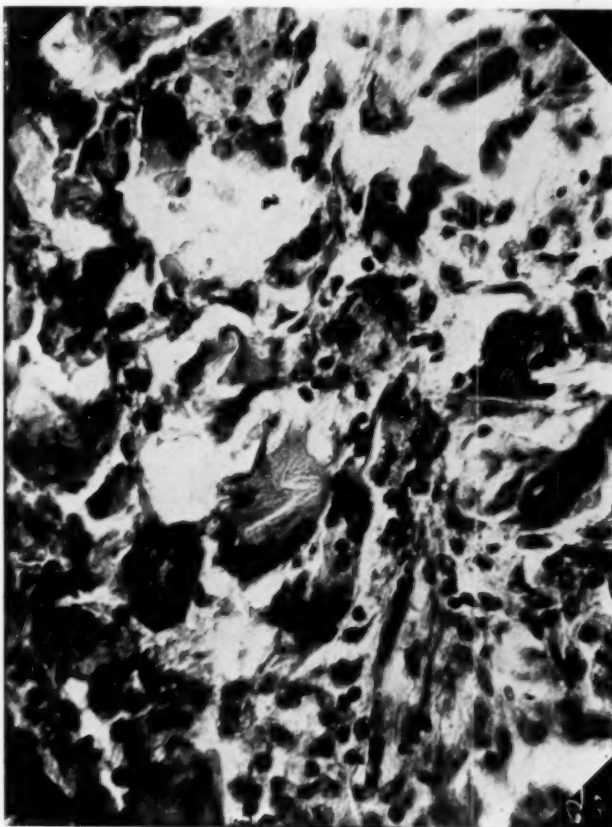


FIG. 8.—Inflammation of hernial sac showing foreign-body giant cells in the case of a girl of twelve who developed a hernia twelve days before operation. (High power.)

CASE VI.—D. C., age thirty-two, male, brass worker. Four days ago while at work in the casting shop, noticed for the first time a painful swelling in the right groin and came immediately to the hospital for examination. There is a small hernia about the size of a walnut in the right groin, somewhat tender on examination, but not giving him enough pain to make him stop working. On close questioning the man says that three weeks before he made an unusual



muscular effort in lifting while at work and states that ever since that time he has felt discomfort and slight pain in the groin, but he paid little attention to it. Operation showed a small indirect hernia about the size of a walnut without any gross indication of inflammatory changes. Microscopically there is a delicate fibrous hernia with a very well marked inflammation of the subendothelial connective-tissue cells with lymphocytes and mononuclears.

From the foregoing histories it is noted that the onset of some forms of inguinal hernia, particularly those brought on by muscular effort or strain, may be associated with a very characteristic inflammation of the subendothelial connective-tissue of the hernial sac (Fig. 3). This inflammation is noticed

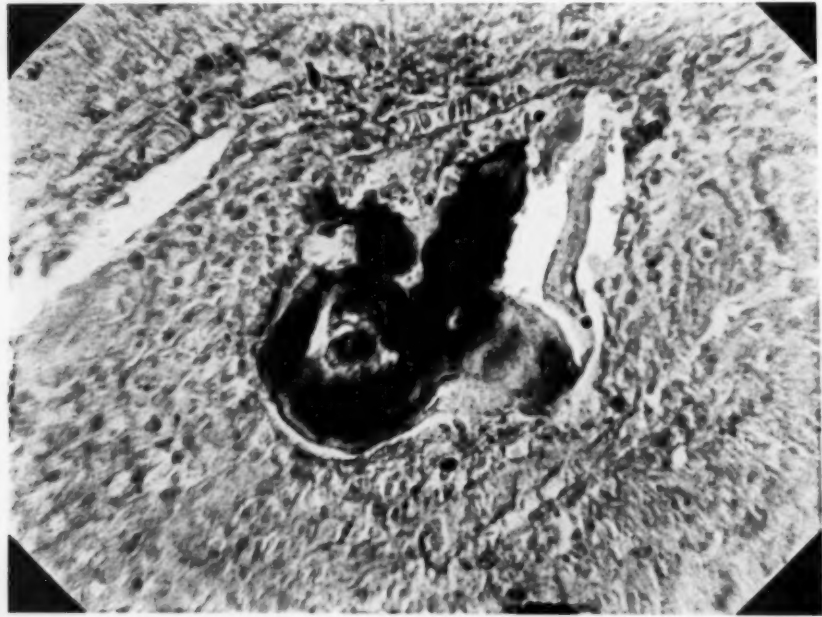


FIG. 9.—Inflammation of a hernial sac due to parasite, *Trichina Spiralis*. This parasite is embedded in the subendothelial connective-tissue of the sac. (High power.)

only in microscopic study of the sac, the gross appearance in no way suggesting an inflammatory condition.

The cases cited were histories of hernia which came to operation soon after the development of their condition, without any indications of imminent incarceration or strangulation. They represent, therefore, ordinary hernias operated on at an early stage and the associated inflammation of the sac may therefore be linked with the early development of the process of hernia formation. All were reducible and without evidences of adhesions in the sac.

From the study of a series of 250 cases it was quite obvious that all hernias do not show such an early inflammation associated with onset, for numerous instances were noted where the sac showed no inflammation at all. This curious inflammatory reaction associated with onset of hernia is a low-grade, subacute process, and seems to be quite different from the usual acute

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manifestations of inflammation in hernial sacs where an incarceration or strangulation of the hernial contents has occurred and rapid polymorpho-nuclear invasion of the wall of the sac develops.

The progress of inflammation of hernia sacs associated with the onset of hernia is a matter of speculation. It is not unlikely that with the adjustment of mechanical conditions at the site of hernia the inflammation subsides, leaving possibly thickened patches in the wall of the sac, or encouraging the formation of adhesion between intestine or omentum and the peritoneal lining of the sac.

### SUMMARY

1. Microscopically, inguinal hernial sacs may be divided into two groups. Group 1, the fibrous hernial sac, representing the usual hernial sac of infancy and childhood and the more common form seen in the adult. It has a tendency to become thickened in the progress of its development.

2. Group 2, the fibrous fatty hernial sac. There is a tendency of fatty tissue to replace the fibrous and elastic tissue situated below the lining endothelium.

3. Inflammatory changes were found in thirty-seven out of two hundred and fifty inguinal hernial sacs removed at operation.

4. Inflammation occurred under a variety of conditions: in the form of aseptic inflammation, infectious (tuberculous), or by parasites (*trichina spiralis*).

5. A subacute inflammation of the subendothelial connective-tissue of an inguinal hernial sac may be associated with the onset of hernia following muscular effort.

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## CHRONIC RETENTION OF URINE IN YOUNG BOYS DUE TO OBSTRUCTION AT THE NECK OF THE BLADDER\*

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ABOUT eight years ago under the title "Chronic Retention of Urine in Children," I brought together a study of this condition as illustrated by a series of nine personal observations and published same in the *Journal of the American Medical Association*. Since this publication it has been my good fortune to be able to study more than twenty cases of the same condition. I propose in this paper to describe three of these cases, treated by me with considerable success and again call attention to this unusual clinical entity.

Judging from literature, this clinical picture has very rarely been observed either by pediatricists or by surgeons. In view of the above, it has been necessary for me in working out the clinical entity and its treatment, to interpret the clinical picture and its causation without the usual coöperation that one obtains from other clinicians who have observed the same condition. During recent years, medical men hereabouts seem to be recognizing this condition more and more frequently and a number of them, appreciating the importance of the pathological changes, have referred such cases to me. On one day, about two years ago, two cases of this type were brought to my office for diagnosis and treatment. In my original paper in the *Journal of the American Medical Association*, various etiological factors underlying this condition were mentioned; against others, congenital obstructions in the male urethra, deformities of the bladder, such as diverticula, stones in the bladder and, last but not least, neurological disturbances which cause a disharmony between the sphincter at the neck of the bladder and the detrusor muscles. The major number of the cases reported in that paper fitted into the latter group as no obstruction in the urethra, no stone in the bladder, no diverticula was demonstrable. As the condition occurs only in male children, the problem of causation has been particularly difficult prior to the introduction of the cystoscope and urethroscope suitable for exploration of the urinary organs in children.

The clinical picture briefly is the following: The parents report enuresis day and night with perhaps straining at urination; dribbling is a frequent symptom. When the urinary organs become infected, pyuria, perhaps accompanied by pain over the bladder as well as in one or both kidneys, may be a permanent symptom. The patients, suffering as they are from chronic sepsis, gradually lose ground, become pale and pasty, and look like chronic nephritics. Such patients, if sufficient kidney parenchyma is destroyed, actually are suffering from renal insufficiency. On physical examination after voiding urine, which may or may not be turbid, which may or may not be

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\* Read before the New York Academy of Medicine, October 18, 1923.

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passed in fair stream, there is regularly to be felt in the hypogastrium a symmetrical, often centrally placed, tumor which is an enlarged distended bladder containing residual urine. This mass can be regularly emptied with a catheter which proves the diagnosis. At times the mass is asymmetrical and to one side, and then from palpation alone there may be some doubt as to the nature of the tumor until the catheter is passed. If infection has set in, the mass may be very tender, and if it is deflected to the right side, it has been mistaken for an appendicular abscess. The pathological findings in some



FIG. 1.—Case I, W. M. Chronic retention of urine in a child. Cerebral birth palsy. Residual urine 6 to 12 ounces. Extensive diverticulation of the bladder. Dilatation and infection of left ureter and left kidney. Operative findings, contracture of the neck of the bladder.

half-dozen cases that have come to autopsy—which is the end result of untreated cases, show no obstruction in the posterior urethra or in the anterior urethra, in that larger group of cases which originally I thought might be explained on a peripheral or central neurological basis. The bladder in these cases is much hypertrophied and pouched, one or both ureters are distended, dilated, one or both kidneys are hydronephrotic or pyonephrotic depending upon the presence of infection or not. Examination of the spinal cord in the few cases examined has shown in the sacral region what has been interpreted as an infiltration of inflammatory character near the anterior horn

cells. In other cases there has been a delayed myelinization. The neurological findings have not been very conclusive. With these preliminary remarks, I place on record three cases, all of which have been treated operatively.

CASE I.—W. M. The first case has been under observation for almost twelve years and it was the study of this case that allowed me to come to a correct interpretation of the condition and its proper treatment. When first seen, the boy was six years of age and the complaint was difficulty in urination. He was a face presentation and remained asphyxiated for one hour and a half after birth. Anuria was present for a week after birth but this is not certain; thereafter,

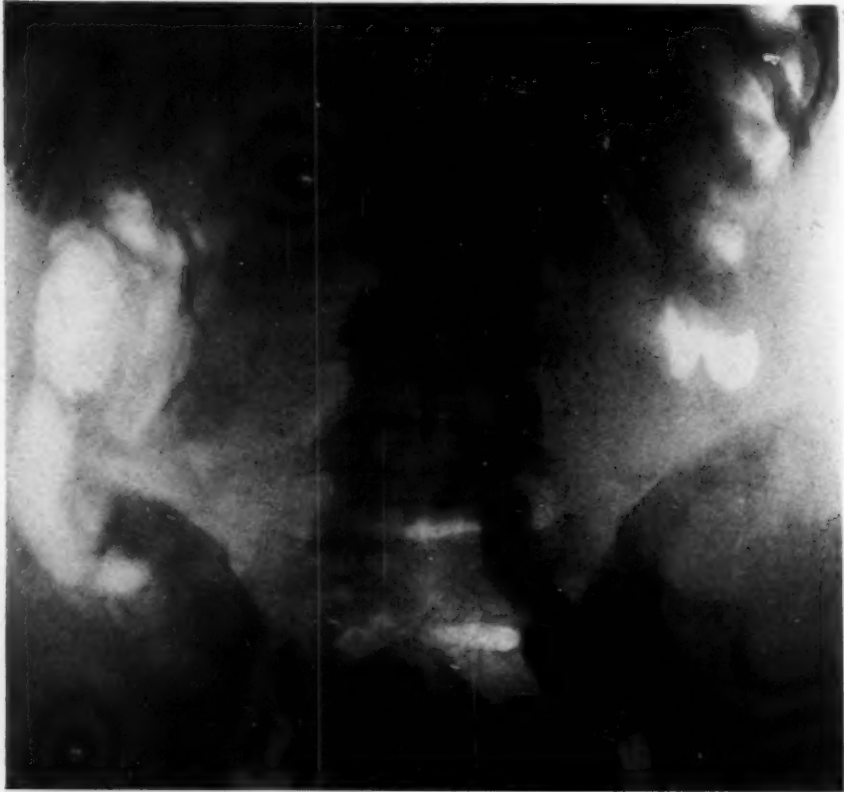


FIG. 2.—Case I. W. M. Chronic retention of urine in a child. Cerebral birth palsy. Residual urine 6 to 12 ounces. Extensive diverticulation of the bladder. Dilatation and infection of left ureter and left kidney. Operative findings, contracture of the neck of the bladder.

the patient dribbled. At the age of two there was pain on urination. At three he began to walk and the left side of his body was noted as weak. There was frequency of urination and straining; the straining was so severe as to cause pallor, weakness and general distress. When first seen, he looked pasty, underdeveloped and pale suggesting chronic nephritis. On physical examination, in the hypogastrium there was a hard tumor which disappeared on catheterization. His neurological examination showed a left-sided weakness, bilateral Babinski, with atrophy of the intrinsic muscles of the hand suggesting an old cerebral hemorrhage or Little's disease, plus a cervical cord poliomyelitis. Cystoscopy made in 1912, showed a trabeculated bladder with delayed secretion from both kidneys as tested with indigocarmin; a diagnosis of retention of urine, some twelve ounces of residual urine being obtained, due to neuro-muscular disturb-



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ances caused by injury at birth. It was thought that there was a sphincter spasm or contracture, and progressive dilatations with bougies were instituted. After the passage of such bougies, the patient was able to empty his bladder. The patient was again seen in March, 1915, still pale and general appearance of nephritic. The bladder was two-thirds up to the umbilicus. On straining, the patient could void only one-half ounce of urine which was clear. At irregular periods, the neck of the bladder was dilated until March, 1921, when the boy had grown sufficiently to permit of a urethroscopic examination. This time he had ten to sixteen and a half ounces of residual urine. His bladder was trabeculated and full of pouches. His posterior urethra at the neck of the bladder showed a thick bar formation such as one sees in adult contractures of the neck. His right kidney secreted indigocarmin in faint concentration in fifty-five minutes. The left kidney was practically negative. The urea on the right side was 1.3 per cent.; on the left .6 per cent. There was no pus present in either kidney specimens. His Wassermann was negative. His neurological status was unchanged and his blood chemistry was: Urea N. 21 mgm.; Incog. N. 52.5. In view of the urethroscopic findings, it looked as if we had an explanation for the disturbance in this particular case. X-rays showed a diverticulated, large bladder and bromide ascended the left dilated ureter. On April 30, 1921 a suprapubic cystotomy was done and a large wedge was excised from the neck of the bladder. This wedge showed muscle tissue with fibrosis. No other obstruction was felt in the posterior urethra, either with an instrument or after dilatation with the examining finger. The patient was discharged in June, 1921, with a residual of one and a quarter ounces of urine. In February, 1922, the patient's symptoms recurred and stones were found (in another hospital) in the patient's bladder. These were removed and suprapubic drainage again instituted. The patient came under my observation again on February 17, 1922 when we found that the left ureter and kidney, which had become infected, contained numerous calculi which were being fed into his bladder and obstructing his neck. On February 19, 1922, before one of the genito-urinary societies, a complete nephro-ureterectomy for infected calculous hydro-uretero nephrosis was performed. The patient made a good convalescence. When seen on January 11, 1923, his residual was four ounces and he had gained twenty pounds. His frequency of urination during the day was one and a half hours and once to twice at night. His urine on June 18, 1923 was clear, and his frequency was as above. Urgency at times was so marked that he had to use a bag after voiding. His residual was one and a half to two ounces. At night his bladder capacity was as much as twelve ounces which he voided in a good stream. This, then, is a patient under observation a long time for chronic retention of urine, associated with an extensive neurological disturbance, almost completely relieved of his residual urine or chronic retention by excision of the neck of bladder. (Vide Figs. 1 and 2.)

CASE II.—I. S. First seen in December, 1921, at the age of six. Since babyhood has been dribbling, has had headaches and nausea. He was delivered normally but was blue at birth. There were no convulsions; no paralyses. Neurological examination was negative, as was the spine. He passed water in good stream but after voiding, his bladder was almost up to the level of the navel. If the patient voided in steps, that is, at three to five minute intervals, he could reduce the size of the bladder mass by evacuating urine at each attempt. His residual urine was twelve ounces. Cystographic study showed a large columnar diverticulated bladder with a left hydro-uretero nephrosis. Cystoscopy showed poor indigocarmin output; right kidney was not delayed whereas left was. Bladder was full of purulent urine, and in the posterior urethra with a urethroscope, a bar formation was seen at the neck and no congenital folds were visible. The patient was prepared for operation by the use of a permanent catheter. He had a high temperature, left kidney was tender and the urine continued purulent. His blood chemistry was normal whereas his phenolsulphonephthalein test in the first two hours was 5 per cent. and in the next two hours 10 per cent. He weighed 33

pounds. On January 16, 1922, a suprapubic cystotomy was performed and thick foul pus was seen coming from the left ureter orifice. No folds were felt with a probe in the posterior urethra. The neck of the bladder seemed minute and rigid as well as inelastic. A wide "V" excision was made through the posterior lip of the sphincter after it had been stretched, and the mucous membrane of the bladder was attached to the mucous membrane of the posterior urethra, with a mattress stitch placed on each side to control bleeding. The pathological report showed a section of the bladder wall with an area of chronic inflammation under the mucosa. On February 11, 1922, the patient weighed 41½ pounds, his bladder wound was closed nicely and the patient was discharged on this date voiding urine

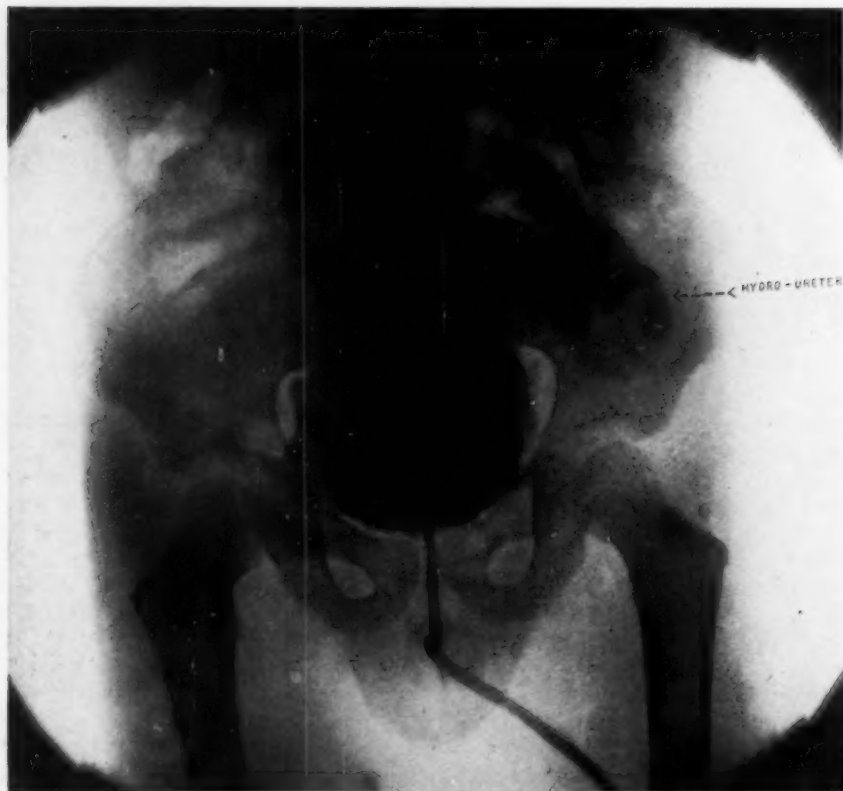


FIG. 3.—Case II, I. S. Chronic retention of urine in a child. Cystogram showing large bladder and dilated left ureter.

in excellent powerful stream. His suprapubic wound opened after his discharge from the hospital on several occasions but rapidly closed again. When seen on December 30, 1922, the patient was in excellent condition. There was no tenderness over either kidney and there was no dribbling of urine. The patient voided in good stream and no mass could be felt after voiding in the hypogastrium. This is another case, then, of chronic retention of urine in a child due to an obstruction at the neck of the bladder which had led to a marked left hydro-uretero nephrosis where, after excision, the bladder emptied itself satisfactorily, the dribbling ceased, nocturnal enuresis was done away with and the general health of the patient was marvelously improved. (Vide Case II, Fig. 3.)

CASE III.—A. L. When first seen on December 6, 1922, was 8½ years of age. There was no difficulty at birth and no paralysis. The patient's parents noticed one month before their visit to my office that the urine was purulent, that there was

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marked frequency and vomiting. The patient was well nourished, voided in good stream, and after voiding very turbid urine, his bladder continued full up to the navel. After voiding at the hospital some 500 c.c. of foul urine, a catheter was introduced which drained off within an hour over 1500 c.c. of purulent urine representing residual urine plus what there was in the ureter and pelvis on both sides, plus whatever had been secreted during the time that the catheter was in the bladder. His phenolsulphonephthalein test showed 5 per cent. in six hours. His blood urea was 37.8 mgm. Neurological examination and X-ray of the spine were negative. The patient was evidently uremic, very drowsy and apathetic. Cystogram showed a large diverticulated bladder and bromide ascended both



FIG. 4.—Case III, A. L. Chronic retention of urine in a boy. Cystogram showing ascent in both ureters.

wide open ureters. The patient's bladder was emptied intermittently through an indwelling catheter, and when his condition, which was always desperate, seemed slightly improved, without any preliminary cystoscopy or urethroscopy, a cystotomy was done, on November 15, 1922, and within the bladder close to the sphincter a fold of mucous membrane was found which acted as a valvular obstruction to the outflow of urine. This was excised into the neck. Jets of pus were seen coming during the operation from both the dilated ureter openings. The patient made an excellent convalescence, the wound closed, then re-opened on several occasions. Under bladder irrigations the condition of his urine improved somewhat and the patient rapidly grew taller and fatter, his residual urine dropped to less than one-half ounce, and when last seen on August 11, 1923, his weight was 69 pounds, he voided in good stream, the suprapubic wound had been closed for several months, his urine still contained pus, and his residual urine was one-half ounce. (Vide Case III, Fig. 4.)

## LOCOMOTION AFTER IMPACTED FRACTURE OF THE NECK OF THE FEMUR

BY KELLOGG SPEED, M.D.

OF CHICAGO, ILL.

THE two following instances of impacted fracture of the femoral neck where the patient was able to walk after the accident, have come to me within the last year.

CASE I.—Mrs. R. E. W., widow, aged sixty-four years, was referred to me on August 30, 1922, with the history that seventeen days before she had fallen



FIG. 1.—The rotation of the head, with an increase of the angle of the femoral neck and the deep impaction of the neck into the trochanteric fragment are clearly seen. The angular deformity with overriding is shown on the inner side of the neck.

riding a slight lengthening of the leg might have resulted. The neck axis instead of being reduced below 130 degrees as in the usual fracture of the neck of the femur, seems to be increased about 8 degrees. On examination, I found that the greater trochanter was situated about three-quarters of an inch above the Roser-Nelaton line, and measurements of the leg showed a shortening on this side of about one inch. These two findings fitted in with the overriding impaction shown in the skiagram. There were ecchymoses still present about the hip and some tenderness

on the floor and injured her left hip. She was helped up, but could walk alone, and had but little pain. She had broken this same leg in childhood just above the ankle, but had sustained no other injury since. After a few days ecchymoses appeared about the hip and because the pain did not completely disappear a physician was called. She was sent to the hospital and a skiagram of that hip was taken. (See Fig. 1.) This clearly revealed an impacted fracture of the neck of the femur. The trochanteric fragment is apparently driven up into the head, which is rotated downward and inward, so that if there were no over-

## IMPACTED FRACTURE OF THE NECK OF THE FEMUR

on deep pressure over the head of the femur, with scarcely any tenderness when the trochanter was struck light blows. Her leg was in normal axial position and the foot could be turned with some limitation of inward rotation. She could raise the leg and foot off the bed freely and had been walking about with no support since the accident.

Fearing that a disimpaction might result from use and slight twists, she was kept in bed about one week and then, being fitted with a walking caliper, was allowed to get up and to walk. She wore the caliper about eight weeks, since when she has walked unaided, with no limitation of hip motion, but with a persisting leg shortening of one inch.

### CASE II.—Mrs.

H. P., a widow, sixty-five years of age, was sent to me May 22, 1923. She had fallen the day before from a step ladder. I found an impacted Colles' fracture of the left radius with fracture of the ulnar styloid. She also had injured her left hip, but had been able to walk after the accident, at first with some assistance. She had climbed the hospital stairs from her automobile when she was brought for attention. She could raise the left leg and foot from the bed readily. The trochanter was

found to be one inch above the Roser-Nelaton line. There was some tenderness in the hip region, but no crepitus nor pain when the trochanter was pounded. When her legs were measured, the left was one inch shorter than the right.

Skiagrams were taken proving the wrist fracture and showing also an impacted fracture of the neck of the left femur. (See Fig. 2.) The fracture plane lies higher up, near the head, in this patient. The trochanteric portion of the neck is driven into the head, which is rotated downward and inward. In this instance likewise the angle of the neck, instead of being reduced, is slightly exaggerated and the impaction does not seem quite so firm as in the first patient. Fearful of a bony separation, her leg was attached to an old-fashioned Liston splint for about ten days. Meanwhile a walking caliper was ordered and as she was rapidly gaining use of her left hand following reduction of the Colles'



FIG. 2.—This fracture is high up into the head of the bone. The head of the femur in this case is also rotated so that the neck angle is increased instead of diminished. The impaction is deep and on the outer aspect of the neck more than the inner, on account of the head rotation. The overriding is plainly seen again on the inner aspect of the neck.



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fracture, she was allowed to leave the hospital, using the caliper and a cane. A week later she was walking out of doors and within six weeks made a railroad journey to the Atlantic coast, travelling without the caliper or support of any kind. I have seen her within a week and she has no limp and gets about with spryness. The leg shortening still persists but has not increased.

To bring about this happy impaction I believe several factors are required. The break in the neck must come before or simultaneously with the impact of the hip on the ground or other object. To maintain or increase the neck angle as seen in these two patients, the leg must not be in adduction, but following the severance of the neck, when the leg was started into adduction, as is shown by the head rotation inward and downward, the powerful external rotators of the femur must act to pull the shaft and trochanteric portion out into abduction. At this instant the impact of the body weight striking the ground, transmitted through the hip, must firmly mesh the two fractured surfaces together so that they hold their position and will tolerate weight bearing and use. Should the impaction be of insufficient depth or at an angle less than the normal angle of the femoral neck, we may expect that the impaction will be broken up by attempted use or manipulations and the usual displacement of fragments will result. This mechanism is much like that which causes intertrochanteric fracture which I described (*Amer. Jour. Surg.*, May, 1921), and it appears that the patient must fall slightly backwards, with all the weight thrown onto the injured hip, and must make a supreme muscular effort to catch herself by action of the external rotators of the thigh.

## THE PROGNOSIS IN EPIPHYSEAL LINE FRACTURES\*

BY MORRIS KELLOGG SMITH, M.D.

OF NEW YORK, N. Y.

THIS paper is a study of thirty-three cases of epiphyseal line fractures observed largely in the Out-patient Department, but to a certain extent in the wards of St. Luke's Hospital. No case has been included which has not been followed and radiographed at least six months after injury. The inquiry, which was stimulated by the occurrence in a youth of premature ossification with resultant deformity after separation of the lower radial epiphysis, has been made with a view to determine the incidence of untoward sequelæ in these types of injuries. The literature contains numerous reports of cases where marked shortening has occurred after epiphyseal fracture. There is little which gives a definite basis for prognosis further than the common consent that unfortunate late results are infrequent.

Ollier<sup>1</sup> has shown that the epiphyseal cartilage is stimulated by trauma at a distance to increased activity, thus explaining the increase in length often observed in long bones after diaphyseal fracture, and on the other hand that when the cartilage itself is injured a retardation of growth takes place. Thus in young animals whose epiphyseal cartilages he traumatized by cutting and stabbing with needles, there was after three or four months a shortening of the affected bone proportional to the damage done. He also found an increase of thickness in the injured extremity. The shortening is due to a slowing of growth rather than premature ossification, but ossification takes place more promptly than on the uninjured side. In experimental epiphyseal separations Ollier found that if reduction was made, shortening, although present, was so slight that it could be disregarded. In the unreduced separations, however, there was considerable arrest of growth. He explains the lack of shortening after most separations by the fact that the fracture line ordinarily runs in the newly forming bone adjacent to the cartilage rather than through the cartilage itself. When the epiphyseal cartilage was ablated complete arrest of growth took place. Ablation of the juxta-epiphyseal portion of the diaphysis produces an arrest of growth greater than the length of bone removed but less than when the cartilage is destroyed.

Bruns<sup>2</sup> studied a series of epiphyseal separations which were observed directly, either because compounded, or at autopsy. Of sixty-one cases twenty-eight were pure separations, that is without accompanying diaphyseal fracture, of which only five showed separation in the cartilaginous substance itself. This indicates the relative resistance of the cartilage to injury.

To summarize, experimentally, arrest of growth is proportional to the

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\* Read before the New York Surgical Society, November 28, 1923.

amount of direct injury to the cartilage, and ordinarily in epiphyseal separations the fracture line is found juxta-epiphyseal rather than in the cartilage itself.

Poland<sup>3</sup> in his extensive work, "Traumatic Separation of the Epiphyses," published just after the introduction of X-ray diagnosis, collected a large number of cases including fifty-six instances of arrest of development. Following him there has been a considerable literature on epiphyseal separation, and it was one of the subjects of discussion at the French Surgical Congress in 1904. Numerous instances of arrested growth have been reported. Of late years interest in this subject has been much less lively, judging by the lesser number of articles which have appeared.

Epiphyseal fractures are common injuries but it is my experience that unless they are looked for many will be classed as ordinary fractures and some, where the amount of separation is slight, will be considered sprains. In the present study I have included among epiphyseal line fractures, cases where the fracture runs into the epiphyseal line as well as separations. In more than half of this series the injury included fracture of the adjacent diaphysis.

The thirty-three cases are distributed as follows: Lower radial twelve, lower humeral ten, lower tibial four, upper humeral three, lower ulna two, and metacarpal two. In all large statistics the lower femoral epiphysis is reported as one of the most commonly separated, but as the source of this material is very largely out-patient lower extremity injuries, especially femoral, are not proportionally represented.

It is more satisfactory to consider these cases by region, rather than as a whole, as sequelæ vary depending on whether the epiphysis involved is the one from which active growth takes place. Shortening after epiphyseal injury may be the result of retarded function of the cartilage alone, or there may be premature ossification. From experimental data Ollier stated that shortening was due to retarded proliferation of the cartilage in which, however, ossification took place earlier than on the normal side. This is probably the fact in human injuries. I suspect that in cases of marked shortening, premature ossification will ordinarily be found. Retardation of growth may, however, persist without ossification until such time as it would naturally take place.

There were twelve cases of epiphyseal line fracture of the lower end of the radius, of these five showed shortening, three with premature or earlier ossification on the injured side. To date only one of them has sufficient deformity and disability to make him feel that he has had a bad result.<sup>4</sup> In his case beginning ossification of the epiphysis was observed when first reexamined eight months after the injury. At the end of two years his radius was three-quarters of an inch shorter. A second case showed ossification of the radial epiphysis, prominence of the ulna head and three-eighths inch shortening in six months. He suffered no disability nor had he noted any deformity. As he is, however, only fifteen years of age it is probable that the difference in the

## PROGNOSIS IN EPIPHYSEAL LINE FRACTURES

two wrists will become more marked. The third instance of earlier ossification is a boy who has been followed at intervals of six months, one year, one and one-half years and two and one-quarter years after injury. Only in the last observation was ossification noted on the injured side. The first examination showed a retardation of growth, which after one year increased little if any. At the last examination the head of the ulna was prominent, the radius measured one-half inch shorter than its fellow and inci-

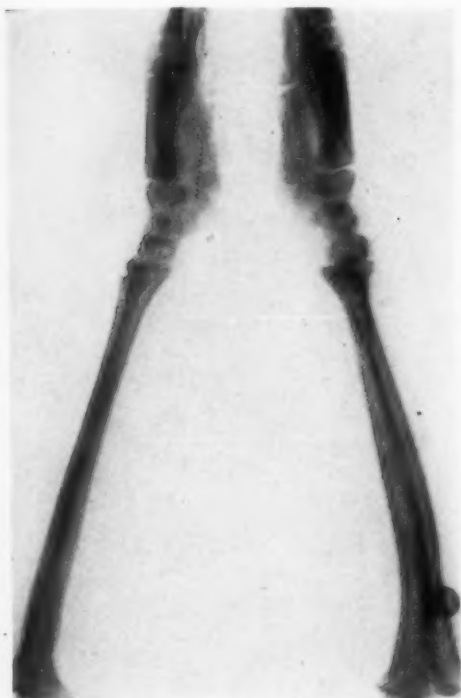


FIG. 1a.—Slight posterior separation of the lower radial epiphysis in a boy of thirteen.



FIG. 1b.—Same ten months later. Note shortening of radius on injured side as indicated by relation to lower end of ulna.

dentally the ulna one-quarter inch shorter than that on the uninjured side. Function seemed perfect.

Of the two remaining cases of shortening one (Fig. 1) examined in ten months showed broadening of the wrist and prominence of the head of the ulna. Measurement of X-rays indicated slightly less than three-eighths inch shortening of the radius. Function was perfect and he and his mother considered the cure complete. The last patient, examined seven months after injury, showed clinically about three-eighths inch shortening. There was no deformity notable, the ulna being also somewhat retarded in growth, and no disability.

The remaining seven cases have excellent anatomical and functional

results. Of them, three on careful measurements of the X-rays had very slight retardation of growth, which in one instance seems to have been overcome in the course of one and one-half years.

The prognosis must therefore be guarded in general in these injuries. The question as to whether it can be made with any definiteness in the individual

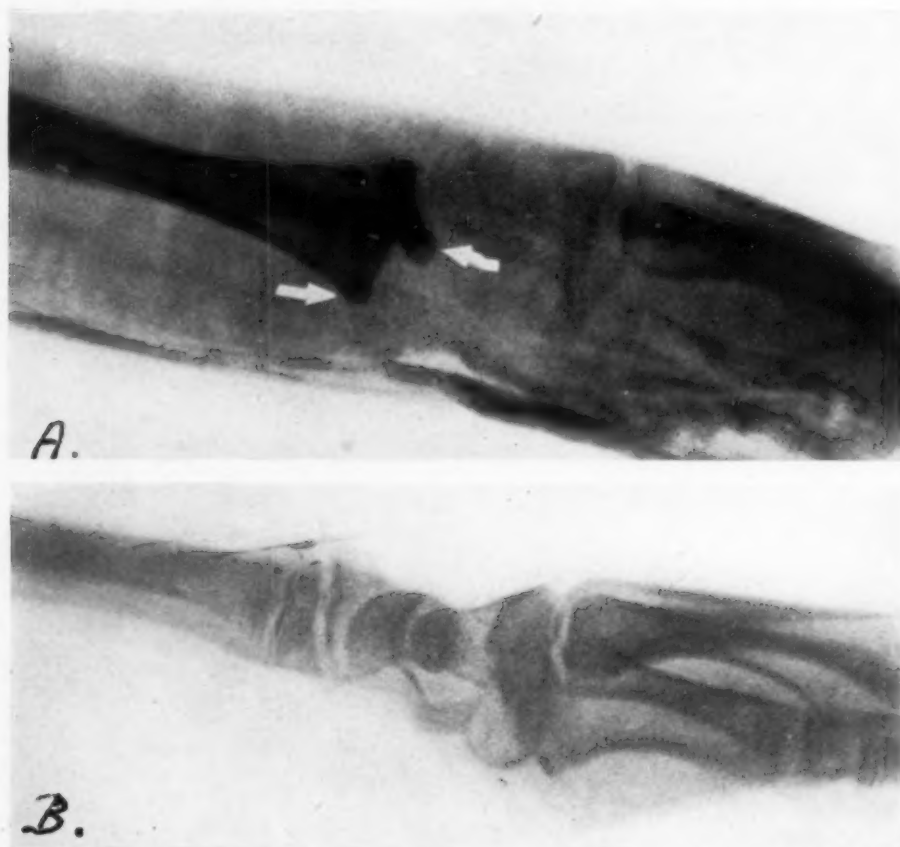


FIG. 2.—Separation of lower epiphysis of radius, with marked displacement backwards of the epiphysis in a boy thirteen years of age. A. Radiograph taken two weeks after injury, after an unsuccessful attempt at reduction. B. Radiograph taken sixteen months later, showing almost complete correction of the deformity by nature. Only the slightest retardation of radial growth can be made out.

case is important. This may be considered from the point of view of X-ray appearance of injury, extent of injury, reduction and age of patient.

*X-ray Appearance of Injury.*—The question whether pure separations were more prone to sequelæ than separations associated with diaphyseal fracture was studied and both types found among retardations and non-retardations. As far as prognosis goes there seems nothing to choose between these two types.

In one instance there was a separation with fracture extending through the epiphyseal end of the bone into the joint. Here it is hard to escape the conclusion that the cartilage itself was severely traumatized at least in



### PROGNOSIS IN EPIPHYSEAL LINE FRACTURES

one place. This case showed retardation of growth of one-half inch and ossification of the injured radius at the end of two and one-quarter years, while the corresponding epiphysis was unossified.

*Extent of injury* as shown by the original deformity does not seem to be any criterion of after result. Of the five patients who showed retardation, in two the original separation was so slight that no reduction was necessary.



FIG. 3.—Fracture through external condyle of humerus into epiphysis in a girl aged nine years. A. Before reduction. B. After two and one-half years; note the premature ossification of the injured epiphysis.

This was the case in two of the seven who did not develop shortening. Massart and Cabuat<sup>5</sup> relate a case in which after a fall there was epiphyseal injury at both wrists, on one side only with displacement. In this case reexamined at the end of three years there was shortening and radial deviation at the wrist on the side which originally showed no displacement, while the other wrist, originally with the more marked injury, appeared normal. A boy not included in this series came to the clinic with some complaint of his wrist. The ulna was prominent and the radius somewhat shortened. His history was that four years before he had injured the wrist. It was considered by his

doctor as a sprain and no X-ray taken. Undoubtedly many cases of so-called sprain are slight epiphyseal separations some of which may go on to deformity.

*Reduction*, as in any other fracture, should be accomplished if the injury is recent, although no guarantee of a good late result. On the other hand, in two of the cases (Fig. 2) in whom the late result was excellent it was impossible to reduce a very decided silverfork deformity, as the patients did not apply until ten and fifteen days after injury. Clinically the deformity has been completely overcome in the course of about a year in both these patients. Another boy with a very marked separation, which radiographically was not



FIG. 4.—C. Z., age thirty-five years. In course of a general examination, deformity of wrists noted. When about fifteen years of age, he hurt both wrists by a fall from a tree. X-ray shows shortening of both radii, the result of epiphyseal injuries.

too satisfactorily reducible at the time, showed at the end of a year a splendid result.

*Age*.—Probably one reason why deformity and shortening are not more often observed after epiphyseal fractures is that they occur as a rule in the second decade when growth is perhaps largely completed. Of the twelve cases in this series only two were under ten years. The average age of the five exhibiting premature ossification and retardation is sixteen years as opposed to twelve years in those without sequelæ. It would seem from this that there is more liability to damage of the cartilage as the time for its function to cease approaches.

## PROGNOSIS IN EPIPHYSEAL LINE FRACTURES

There are four cases of lower tibial epiphyseal fracture of which two show retardation of growth, none premature ossification. Of the two showing retardation one aged thirteen, had a fracture through the epiphysis near the inner malleolus into the epiphyseal line. One year and nine months later the external condyle on the injured side appeared prominent and as if growing toward the sole of the foot. Measurements to the internal malleolus from the patella were one-half inch less on the injured side than on the uninjured. Measurements to the external malleoli were the same on both sides. The second, aged fourteen, had a separation of the epiphysis with supra-malleolar fracture of the fibula, requiring reduction. Two years later the internal condyle of the injured side appeared more prominent and higher than on the normal side. Measurement to internal malleolus was about three-eighths inch shorter than on the uninjured side, to external malleoli same on both sides. Neither of these boys had functional disability. The other two lower tibial cases fourteen and eleven respectively, after one and one-quarter and two and one-half years showed no ill effects. The original injury in the former case was slight separation at the inner end of the epiphyseal line and in the latter a small diaphyseal fracture extending downward to the epiphyseal line. With regard to the type of injury it is noteworthy that in the first case described, which eventuated in retardation, the fracture ran longitudinally through the bony epiphysis into the conjugal cartilage in a manner comparable to the lower radial case in which the bony epiphysis was split into the conjugal cartilage and which resulted in retardation and eventual early ossification.

There are three cases of upper humeral epiphyseal fracture. In the first of these a boy of sixteen, the diaphyseal end was displaced outward and upward. As efforts at reduction were unsuccessful I did an open operation, without local fixation, however, and the deformity recurred. Examination two and one-half years later showed normal function except for slight limitation of internal rotation. Measurement, acromion to external condyle, showed one-quarter inch shortening on the injured side. Ossification had taken place on both sides. On the injured side the greater tuberosity reaches a higher level than the head due, undoubtedly, to union taking place with the head abducted. The shortening is due at least in part, if not altogether, to overriding of the fragments when union took place.

The second case, a girl of fifteen, applied two weeks after injury with a deformity similar in type to that of case one, but less marked, with union already present. No attempt at reduction was made. Fourteen months later clinically there was no deformity nor shortening. The X-ray shows a slight curvature in the upper end of the bone, and measurement of it indicates a little shortening on the injured side. The third case, a boy of thirteen, had a fracture through the surgical neck into the epiphyseal line, with a slight angulation. Sixteen months later he was perfectly restored clinically and radiographically. Of the three cases none can be cited as unquestionable examples of retardation of growth. In the first two cases the excellent functional results, in spite of uncorrected displacements, is noteworthy.

There are two cases of lower ulna epiphyseal fracture. Both of these had considerable separation associated with fracture of the lower one-fourth of the radius. In both primary reduction was satisfactory. One, aged fifteen, showed ossification in the injured ulna nine months after injury, and in sixteen months ossification of both bones of the injured side was completed while those of the uninjured side were well along. There was no shortening in this case. Functionally pronation was slightly limited. The second was thirteen at the time of injury. Two years later no difference could be made out in his wrists. Careful measurement of the radiograph showed very slight retardation of the injured ulna. Of these two cases ossification was stimulated in one, there was no notable shortening in either.

These four groups of injury of the actively growing epiphyses of long bones naturally fall into one larger group as follows:

	No. of cases	Retardation	Premature ossification †
Lower radius .....	12	5	3
Lower tibial .....	4	2	0
Upper humerus .....	3	0	0
Lower ulna .....	2	0	1
	—	—	—
Total .....	21	7	4

The lower humeral epiphyseal fractures should be considered apart from the previous group, as growth from this epiphysis is relatively slight, consequently retardation of growth does not have to be particularly reckoned with. In the follow-up X-ray studies broadening and alteration of outline of a condyle was frequently noted.

There were ten cases in this group of whom one was a dislocation inward of the lower epiphysis, with fracture of the internal condyle; one a separation of internal epicondyle with evidence of slight injury on capitellar end of epiphyseal line; five fractures of the external condyle extending into epiphyseal line; two complete outward dislocations of the capitellum; and one separation of internal epicondyle alone. The age of this group averages lower than that of the remainder—nine years plus.

One of the number (Fig. 3) examined two and one-half years after injury, showed premature ossification of the lower epiphysis. She was nine years old when hurt. X-ray showed a fracture of the external condyle and capitellar epiphyseal line extending into the epiphysis. Reduction was made under gas and the arm treated in acute flexion. At the follow-up, the

†It is doubtful whether to class the boy with the early ossification of the lower ulna epiphysis as premature ossification. In his case there has been no retardation of growth. Ossification, as shown by X-ray may not necessarily take place at exactly the same time in normal corresponding epiphyses. On the other hand in this case ossification seemed to be definitely stimulated in the injured wrist. I have one radiograph taken two years after lower radial epiphyseal injury in which the uninjured radial epiphysis is in process of ossification while that on the injured side showed no sign, although slightly retarded in growth.

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elbow seemed perfectly normal in appearance and function. Measurements of both arms were the same. The X-ray showed an apparent broadening and shortening of the external condyle as well as the premature ossification.

A second case, a boy of fourteen, who had a separation of the internal condyle and evidence of slight injury at the outer end of the capitellar line, showed after six months' ossification of the lower epiphysis on the injured side, while the line could still be seen on the uninjured side. At the end of a year ossification was complete on both sides. In this case it would seem that ossification was hastened by the injury (not rated as premature ossification).

Only one case showed a notable deformity, a girl aged eight who had an inward separation of the lower epiphysis with fracture of the internal condyle. Apparently it was never successfully reduced and she has a gunstock deformity with good function. Measurement from the acromium process to the external condyle showed one-half inch lengthening on the injured side.

All the rest have excellent results. In none was there shortening noted clinically.

Examination of the radiographs show evidence of growth alterations by apparent widening of the lower end of the humerus in several, slight lengthening in three, including the one just described, and retardation of growth of the external condyle in two. Besides the gunstock case those showing a slight lengthening were both instances of dislocation of the capitellum outward, requiring open operative reduction.

Both cases of separation of the internal epicondyle failed, after one and two years respectively, of osseous union. This is characteristic of the majority of these cases according to Poland.<sup>4</sup> In both the epicondyle was displaced downward.

There remain two boys with epiphyseal fracture of a metacarpus, aged thirteen and six years. In both there was flexion of the head of the bone, in each case resulting immediately in slight shortening which has remained unaltered through the follow-up period of more than a year. Neither has shown premature ossification.

During the time when this study was being made five cases of old epiphyseal injury, with growth alterations, three of lower radial, two of lower ulna, have been observed. In three of them there was marked deformity (Fig. 4). None of them have been included in this series.

*Summary.*—Thirty-three cases of epiphyseal line injuries have been followed up. Of these there were twenty-eight boys and five girls. The average age was twelve years plus. Only eight were ten years or less, the majority of these being in the lower humeral group.

Fifteen per cent. showed premature or earlier ossification. This was found as promptly as six months after injury in one case and as late as two and one-quarter years in another.

Retardation of growth to a slight degree is common. It was present in thirty-three per cent. of twenty-one injuries to actively growing epiphyses



of long bones. There was decided deformity from shortening in two cases of the twenty-one, or about ten per cent.

Retardation of growth may persist without premature ossification. From a study of this series it appears that a retardation of growth is seldom compensated later. In lower radial injury with retardation a lesser ulna retardation is often associated, with or without ulna fracture.

There seems to be a marked tendency for natural correction or compensation of epiphyseal separations to take place in such as have not been reduced.

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## SPINAL ANÆSTHESIA

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NOTWITHSTANDING the uniformly good results obtained with spinal anæsthesia in the hands of experienced operators and the numerous advantages and relative safety of the method, it is somewhat strange to note the reluctance of many surgeons in adopting its use. This reluctance is attributable to a number of factors to which we shall refer later. However, the review of the literature shows a slow but steady progress in the adoption of the method, and although at present it is far from universally adopted, it would seem that the time is not far distant when spinal anæsthesia will be sanctioned by the entire profession and employed in appropriate cases by all surgeons. In our opinion, the method has a large and important field of usefulness, and should, therefore, be a part of the armamentarium of every surgeon. The careful recording and publication of results obtained with spinal anæsthesia in the hands of various operators will perhaps do more than any one thing in establishing the proper status of the method. It is with this idea in mind that we are submitting this brief account of our experience with spinal anæsthesia.

Our series includes 387 cases and covers a period of two years. Although we appreciate the fact that this is a comparatively small number of cases, it appears to us sufficient for a fair trial of the method and to permit some conclusions. Before proceeding with the report of our experience with spinal anæsthesia, a very brief resumé of the subject may be apropos.

*Definition.*—Spinal anæsthesia is the loss of sensation produced by the injection of anæsthetic drugs into the subarachnoid space. It is essentially a nerve block induced by the action of the drug on the sensory nerve roots within the subarachnoid space. We consider "subarachnoid analgesia" a more proper term than spinal anæsthesia.

*Historical.*—J. Leonard Corning, of New York, in 1888, injected solutions of cocaine between the spinous processes for the relief of pain in cases of spinal disease. He did not puncture the dura, but produced analgesia by injecting around the spinal nerve roots extradurally. Although this, in reality, was the method now termed paravertebral analgesia, it served to suggest the intra-dural injection of anæsthetizing solutions.

August Bier, of Bonn, in 1899, was the first to induce analgesia by the injection of cocaine into the subarachnoid space. He tried the method on his assistants and also acted as a subject himself. Later in the same year, Tait performed the first operation in America with spinal anæsthesia. Fol-

lowing this, the procedure was adopted by quite a number of operators, but due to its unpleasant experiences was promptly abandoned by most of them. With cocaine there were numerous untoward effects and a number of deaths.

In 1903, Fournau isolated stovaine, and in the following year Einhorn isolated novocain. With the discovery of these drugs, the method received a new impetus. The technic of induction was improved and spinal anæsthesia became a safe procedure. It has steadily gained in prominence, so that at present it is rather widely used. In many of the large European clinics, it is the method of choice. In this country, although there are numerous operators who have had extensive experience with the method and are enthusiastic with the results, its progress has been somewhat slow. Some of the factors which have retarded its adoption are:

(1) Prejudice of those who have had no experience with the method. This prejudice appears to be based, firstly, upon a peculiar dread on the part of many physicians to puncture the spinal membranes. Fear of infection or paralysis seems to be the foundation of this dread. However, the harmlessness of spinal puncture as demonstrated by routine spinal fluid examinations in the syphilis clinics should remove any such dread of dural punctures, providing a simple yet careful aseptic and antiseptic technic is followed. In the last ten or fifteen years, we have performed lumbar punctures for diagnostic and therapeutic cases in between one and two thousand cases of lues without a death or complication. Secondly, fear of uncontrollable action of the anæsthetizing drug after injection also seems to be a prejudicial factor. This factor can only be removed by a thorough knowledge of the principles of spinal anæsthesia.

(2) Unsatisfactory and at times fatal results attending the use of the method in the hands of those who are careless or unfamiliar with the principles of spinal anæsthesia have also retarded its use.

(3) In some instances unpleasant results have been due to improper selection of patients.

*Mechanism and Phenomenon of Spinal Anæsthesia.*—The effects of spinal anæsthesia are those produced by the influence of the drug on the motor and sensory nerve roots within the subarachnoid space, on the cord itself, and its effects after absorption in the blood stream. Its influence on the cord is only slight, so that the conducting columns continue to function. The spinal nerve roots acted upon and resulting areas of the body anæsthetized depend upon the following factors:

1. Posture of the patient following injection.
2. Specific gravity of anæsthetizing solution.
3. Normal secretion, excretion and circulation of spinal fluid.
4. Quantity of spinal fluid removed.
5. Dosage of drug.
6. Bulk of solution.
7. Point of injection.
8. Rapidity of injection.

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Ordinarily, providing there is no contra-indication, the injection is made with the patient in the sitting posture. The subsequent position of the patient is determined by the specific gravity of the solution injected. Babcock<sup>1</sup> uses a solution either much lighter or much heavier than spinal fluid with the idea of controlling the influence of the drug by the position of the patient. The specific gravity of spinal fluid ranges from 1.006 to 1.008. If the heavy solution containing lactose, and which has a specific gravity of 1.020 is used, the head and shoulders of the patient are kept elevated, and if the light solution, containing absolute alcohol and with a specific gravity of 0.992 is used, the head and shoulders of the patient are immediately placed in a position lower than the hips, and retained in that position for at least one hour after injection. Such solutions rapidly find their level in the caudal portion of the subarachnoid space and the normal circulation of spinal fluid toward the periphery tends to keep the drug localized.

Labat<sup>2</sup> and others dissolve the anæsthetizing drug in spinal fluid, thus producing a solution only slightly heavier than spinal fluid. After the injection of such a solution, the patient is immediately placed in a position with the head and shoulders slightly elevated. Such a solution will diffuse downward below the point of injection and to a lesser degree upward. Its diffusion upward is obstructed to some extent by a downward circulation of spinal fluid. Passage of the anæsthetic drug into the venous circulation surrounding the spinal membranes begins immediately after the injection, being carried along with the spinal fluid. Within a few minutes (five to ten) the drug has diffused to its full extent and the patient may be put in the Trendelenburg position if this is desirable. The secretion, excretion and circulation of the cerebrospinal fluid play an important rôle in spinal anæsthesia. According to Boyd<sup>3</sup> the fluid is continually being secreted by the epithelial cells covering the choroid plexus and to a certain extent originates from the perivascular spaces of the arachnoid mater. It is also continually passing from the subarachnoid space into the lymphatic system *via* the subarachnoid spaces along the cranial and spinal nerves. There is thus a continuous circulation of fluid, so that the total quantity which in man averages 120 c.c. is perhaps replaced four or five times in twenty-four hours. Thus crystalloid substances such as the drugs used in spinal anæsthesia upon being introduced into the subarachnoid space, rapidly find their way into the vascular circulation aided by the flow of spinal fluid.

The quantity of the spinal fluid removed prior to the injection of the anæsthetizing solution is also a matter of importance. If considerable fluid is removed, lowering the intraspinal tension, the anæsthetizing solution will diffuse more rapidly and more extensively than if no fluid or very little is removed. In general, it may be stated that the more fluid removed, the higher the anæsthetic.

The dosage or quantity of the drug used should be governed by the duration of analgesia required for the operation. One should use no more of the drug than is necessary. The bulk or quantity of solution injected is

also a factor for consideration. Ordinarily, the drug is dissolved in 2 c.c. of either distilled water or spinal fluid. If extensive diffusion of the drug in the subarachnoid space is desired, the solution may be further diluted with spinal fluid. When thus diluted the period of analgesia is shortened. If only a limited low area of analgesia is necessary, the 2 c.c. of solution is injected without further dilution. The point and rapidity of injection are factors concerned in the mechanism which will be discussed later.

The influence of the drug begins almost immediately after injection. First the areas of the body supplied by the segments at the point of injection are affected. Then as the drug diffuses, the action occurs in the areas supplied by the segments above and below the point of injection. As a rule, analgesia is complete within five minutes, and reaches its height of intensity in fifteen minutes. The effect is most marked and lasts longer in the areas supplied by the segments immediately around the point of injection. Just after injection, patients often experience a tingling, numbness, or other paræsthesia in the feet. Loss of sensation and motor paralysis then occurs and is usually complete in the lower extremities except in the small muscles in the toes and the iliopsoas. Occasionally, however, a patient will have complete analgesia and retain motor power. It appears that the anterior motor roots are less exposed and less sensitive to the drug than the posterior roots. Tactile sense is often retained when there is complete loss of pain sense.

*Abdomen and Viscera.*—The abdominal muscles are completely relaxed during spinal anæsthesia. Relaxation is more marked than during the deepest ether anæsthesia. The intestines and stomach are contracted and peristaltic movements are increased. This may be explained by the paralysis of the sympathetic nerve supply, which normally inhibits intestinal movements. The motor influence through the vagi is thus left unopposed.

*Circulation.*—The effect of spinal anæsthesia on the circulatory system depends upon the height reached by the drug in the subarachnoid space. If the action of the drug is confined to the lower spinal segments, little or no change in the circulatory system occurs. When the upper dorsal segments are involved, a slowing of the heart and a fall in blood-pressure occurs. The sympathetic nerve fibres which exert an accelerating influence on the heart leave the spinal cord *via* the anterior roots of the upper thoracic nerves, and when these are influenced by the drug, the vagi are left free to inhibit heart action. The blood-pressure is lowered by the drug acting on the vasomotors, which leave the anterior roots *via* the rami communicantes. Ordinarily, when the abdomen is anæsthetized, the pulse rate becomes ten to thirty per cent. lower than before injection and the blood-pressure falls correspondingly. Occasionally, however, the blood-pressure will drop to a point where it cannot be accurately determined. Such patients require immediate stimulation and respond well to epinephrin, caffeine-sodium-benzoate and strychnia. Considerably less hemorrhage occurs with spinal anæsthesia than with ether or gas anæsthesia. There is also less tendency to post-operative hemorrhage.



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*Respiration.*—The amplitude and rate of respiration are unaffected if the anæsthetic effect is confined below the diaphragm. If the muscles of the thoracic walls are paralyzed, respiration becomes slow and shallow and the patient will complain of a sense of weight on his chest.

*Genito-urinary Tract.*—Careful urinalysis following spinal anæsthesia has failed to show any evidence of renal irritation. The vesical sphincters are not relaxed.

*Skin.*—The skin usually shows no changes during spinal anæsthesia. Occasionally, if the anæsthetic involves the upper dorsal region, the skin becomes pale. Toxic effects, or effects of the drug after absorption into the blood stream are discussed by some writers. Such symptoms as faintness, pallor, nausea, vomiting, dyspnoea are included by some authors as toxic symptoms. It would seem that these effects can be more readily explained by the direct action of the drug on the spinal nerve segments of the thoracic region. Convulsive attacks, lapse of consciousness and sudden cessation of respiration are probably due to the passage of a large dose of the drug into the general circulation.

*Drugs.*—Our experience has been limited to apothesine and novocain. However, we have made use of apothesine chiefly. The results obtained with both of these agents have been entirely satisfactory.

In the beginning of our work with spinal anæsthesia, we employed apothesine tablets. One tablet of apothesine, grains  $1\frac{1}{4}$ , was placed in a sterile test tube containing  $2\frac{1}{4}$  c.c. of sterile distilled water or the same quantity of normal salt solution. If only a limited low area of analgesia was desired, salt solution was used. After covering the test tube with sterile gauze and dissolving the tablet, the solution was sterilized by boiling over a Bunsen flame for five minutes. Such solutions must be freshly prepared and used immediately. Although our results with such solutions were quite good, there were certain disadvantages with this method. The preparation was quite troublesome and time consuming and there was some danger of contamination.

At our request, Parke Davis and Company very kindly prepared sterile solutions of apothesine in ampoules according to the following formulas:

1. Apothesine 0.1 gm. Distilled water 2 c.c. Such a solution we found rapidly diffused over a wide area and about thirty per cent. of patients to whom this solution was administered were nauseated while on the operating table.

2. Apothesine 0.1 gm. Normal salt solution 2 c.c. This solution was quite satisfactory. Very few of the patients were nauseated while on the table after the injection of this solution.

3. Apothesine 0.1 gm. Absolute alcohol 0.2 c.c. Distilled water 1.8 c.c. Such a solution has a specific gravity much lower than that of spinal fluid and was intended for use in cases where the Trendelenburg position was desired. We employed this solution only in a few cases (five). All of the patients were nauseated, and in two, the analgesia was unsatisfactory. We, therefore, discontinued the use of this solution and were later advised by

chemists of Parke Davis and Company that apothesine is incompatible with alcohol.

4. Apothesine 0.10 gm. Lactose 0.10 gm. Distilled water 2 c.c. Such a solution is much heavier than spinal fluid. In using this solution, the patient's head is kept elevated. We have injected this preparation in about 125 cases. The extent of diffusion can be readily controlled by the position of the patient when this solution is employed. This has been the most satisfactory solution in our experience.

Recently Parke Davis and Company have prepared for us apothesine powder 0.12 gm. in 5 c.c. ampoules, which have been sterilized in the autoclave. The apothesine is dissolved in spinal fluid at the time of the operation. The results have been uniformly good with the use of the drug in this form, and we are now using it exclusively. We have found that different lots of ampoules containing solutions prepared according to the same formula vary considerably and each new lot requires careful testing. The use of the ampoules containing the drug in dry form obviates this difficulty. Another advantage is that the patient may be placed in any desired position after injection of the drug dissolved in patient's spinal fluid. We have also used novocain in the same manner with good results.

*Technic and Management of Patient.*—We have not used preliminary narcotization routinely. In a considerable proportion of patients we have found it unnecessary, especially in cases where the operation can be completed in a short time. If the proposed procedure requires considerable time and the temperament of the patient indicates, we administer morphia grain 1/6 and hyoscin gr. 1/100, three-quarters of an hour before operation.

The following apparatus is used: One 5 c.c. Luer syringe; 1 Babcock spinal puncture needle, 19 gauge; 1 Luer needle for aspiration of solution from ampoule; 1 file.

These are sterilized by boiling in distilled water without alkali and are brought directly to the operator.

The ampoules containing the drug are kept in a jar of seventy per cent. alcohol.

Spinal puncture is more easily performed with the patient in the sitting posture. So that unless the patient is weak or presents some other contraindication, we make the injection with the patient seated across the operating table. The patient with arms crossed and back bowed forward and head and neck fully flexed is supported by an attendant. The back is painted over a wide area with three and one-half per cent. tincture of iodine followed by alcohol.

Ordinarily injections through the lumbar spaces will suffice. Occasionally when employing a heavy anæsthetizing solution and desirous of a high field of analgesia, we have made the puncture between the tenth and eleventh or eleventh and twelfth dorsal vertebræ. Usually we select the space with the widest gap between the spinous processes, and in most cases this is the space between the third and fourth lumbar vertebræ. The point of the spinal

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puncture needle is then placed in the midline of the space selected, and after spraying ethyl chloride, it is introduced in the median line into the sub-arachnoid space.

As stated above, we are now dissolving the drug in spinal fluid. After removing the stylet, 2 to 3 c.c. of spinal fluid is allowed to run into the ampoule containing apothesine. The drug rapidly dissolves and the solution is aspirated into the syringe. Ten to 25 c.c. of spinal fluid is allowed to escape into a tube. The quantity of fluid removed is determined by the pressure and the extent of analgesia desired. The syringe is then adjusted to the spinal puncture needle and enough spinal fluid aspirated into the syringe to make 5 c.c. is then slowly injected without force and about 1 c.c. withdrawn. This manœuvre is repeated until the entire quantity of solution has been introduced. After removing the needle, the patient is immediately placed in the prone position with head and shoulders elevated. With this method after fifteen minutes, he may with safety be placed in the Trendelenburg position.

In using the solution of the drug in water or salt solution, the technic differs from the above in that only 2 to 3 c.c. of spinal fluid is removed.

The blood-pressure and pulse rate is noted before the injection and every five minutes after the injection. It has been our custom to administer five minims of 1 : 1000 adrenalin solution together with strychnia, grain 1/30 subcutaneously immediately after the subarachnoid injection. This is given with the idea of forestalling the fall in blood-pressure and slowing of the heart. If the blood-pressure falls to a marked degree, ten to fifteen minims of adrenalin solution is given intra-muscularly. Should a marked slowing of the pulse occur, caffeine-sodium-benzoate, four grains, is given intra-muscularly. Strychnia is also a valuable stimulant in these cases. Elderly patients or patients with impaired myocardium often require stimulation. Sterile normal salt solution and apparatus for its administration intravenously should always be in readiness in the event of circulatory failure.

*Untoward Effects.*—Nausea of a varying degree, either during or just after the operation, has been complained of by fifteen to twenty per cent. of our patients. A slight pallor usually accompanies the nausea. Nausea occurs more frequently with the Trendelenburg position than when the head is kept elevated. This symptom is also more frequent with the use of analgesic drugs dissolved in water or salt solution than when the drug is dissolved in spinal fluid. About two-thirds of the patients who were nauseated also vomited. Nausea ordinarily lasts from thirty minutes to two hours.

Three of four patients complained of a sense of weight on the chest. Respiratory movements were shallow, sighing and eight to twelve a minute in these cases. This condition passed off in a few minutes. Rebreathing through a closed inhaler is helpful in this condition.

Syncope following the subarachnoid injection occurred once in our series. This patient, a male, age sixty-two, with rather marked myocardial degeneration and advanced nephritis, and whom we considered a better risk with spinal anæsthesia than with inhalation anæsthesia, lapsed into unconsciousness five

minutes after the injection. The pulse could not be felt at the wrist and respirations were slow and shallow. Salt solution with adrenalin added was immediately administered intravenously. He was also given caffeine and strychnia. After about five minutes, he regained consciousness. Respiration and heart action promptly returned to a satisfactory condition, and no further difficulties arose. This is the only patient whose condition was alarming while on the table.

In this series there have been no deaths due to the anæsthesia. Only one patient died soon after operation. This case of extravasation of urine in an elderly male admitted to the hospital and operated on when in an obviously moribund condition died eight hours after the operation.

Headache of the spinal type, accompanied by stiffness of the neck muscles, was recorded in eight of our cases. This usually came on several days after operation and none persisted more than ten days. Such headaches are only slightly relieved by the usual remedies. These patients are quite comfortable while lying down and experience pain only when in the erect posture. About fifteen per cent. of patients complained of headache of mild degree and lasting about a day. We have not observed a single case of spinal headache following the injection of the drug dissolved in spinal fluid.

Slight backache lasting a few days was complained of by twelve per cent. of patients.

Temporary paralysis of the external rectus of the eye occurred in one of our cases. This condition appeared eight days after injection and completely disappeared in four weeks. In this case, a solution prepared by dissolving a tablet in water was used. The solution was probably contaminated.

The above are the only untoward effects which occurred in this series, and we feel that these would compare very favorably with the same number of similar cases operated with any form of inhalation anæsthesia. Disagreeable symptoms occurred more frequently in our earlier cases due to our inexperience with the method and also due to the use of various solutions and technics which we were employing in our effort to find the most satisfactory method.

*Failure to Obtain Analgesia.*—Complete failure of the analgesia occurred in six of our cases. In four cases, failure was attributable to the solution. In the other two cases, although spinal fluid was withdrawn, the flange of the needle was probably only partially within the subarachnoid space and extradural leakage of the solution occurred. These cases could have been reinjected, but we preferred to use some other anæsthetic. Imperfect analgesia, but not requiring any other anæsthetic agent, occurred in fifteen cases.

*Post-operative Care.*—Patients operated with this method require much less post-operative attention than patients operated with inhalation anæsthesia. The analgesic effect disappears quite gradually and pain is much less severe than following inhalation anæsthesia. The patients are quite comfortable and ordinarily appear little disturbed by the operative procedure. Abdominal distention is much less than with inhalation methods. Water may be given freely during and after the anæsthetic. It is our custom to allow only liquids



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for at least four hours after operation, and then begin feeding according to the surgical condition present.

If a heavy solution or drug dissolved in spinal fluid has been used, the patient may be placed in the Fowler position immediately upon returning to bed. Patients not requiring this position are placed in bed with one pillow under the head and are not allowed to sit up for at least thirty-six hours. If a solution lighter than spinal fluid has been given, the head should be kept lower than the hips until after the analgesic effect has disappeared. Patients should, of course, be carefully watched until motor power of the lower extremities has returned.

*Scope of Usefulness.*—Spinal anæsthesia may be used with patients of all ages. Although we have had no experience with the method in children, it is stated by numerous writers that it is very satisfactory. It is particularly useful for operative procedures on elderly subjects such as those requiring prostatectomy. Our eldest patient was a physician, age eighty-two, who although a bad risk on account of cardio-renal and pulmonary disturbances, promptly recovered from a prostatectomy.

It is quite safe to induce analgesia affecting the body as high as the nipples; so that the method is suitable for practically all operations below this point. With the exception of cases suitable for other forms of nerve block analgesia, it is the method of choice in all cases presenting pulmonary, cardiac, renal and vascular disturbances. It is also a valuable method in operating diabetic patients.

We have administered spinal anæsthesia for the performance of the following types of operations: Nephrectomy and the various operations on the kidneys; suprapubic cystotomy; prostatectomy; amputation of penis; plastic operations on the penis; circumcision (cases with irreducible phimosis or otherwise unsuitable for local anæsthesia); epididymectomy; orchidectomy; external urethrotomy; appendectomy; cholecystectomy; herniorrhaphy (inguinal and umbilical); hysterectomy, and other pelvic gynecological operations; perineorrhaphy; reduction and plating of fractures of femur and tibia; amputations of lower extremities and hemorrhoidectomy. The great majority of cases were urological and were performed by us at the Colonial Hospital, and a few at the Mercy Hospital. The gynecological and some of the general surgical operations were performed by our associates for whom one of us gave the injections.

*Selection of Patients and Contra-indications.*—Quite needless to say, patients should be carefully examined before administering spinal anæsthesia. Particular attention should be directed toward ascertaining the condition of the myocardium and the blood-pressure should be recorded. Patients presenting marked myocardial degeneration may not tolerate the slowing of the pulse and drop in blood-pressure following the subarachnoid injection. Patients with a low blood-pressure, *viz.*, below 100 systolic, may likewise do badly with spinal anæsthesia. Cases with pericardial or pleural effusions are also poor risks. However, if such patients are also unsuitable for other forms



of anaesthesia, the subarachnoid injection may be made just after the hypodermic injection of strychnia, grain 1/30, and adrenalin chloride solution 1 : 1000 minims X. This together with caffeine-sodium-benzoate may be repeated if necessary. In such cases, one should be particularly careful to produce an area of analgesia just high enough to allow the performance of the proposed operation.

Spinal anaesthesia should be avoided in operating patients with recent untreated syphilis.

Valvular heart disease, unless associated with decompensation, is not a contra-indication. Patients with hypertension are quite satisfactory for spinal anaesthesia.

*Conclusions.*—In our experience with 387 cases operated with spinal anaesthesia, we have noted the following advantages of the method :

The anaesthetic is quickly and, in most cases, readily induced.

Operative shock is avoided by the blocking of the nerve supply of the operating field.

Hemorrhage is less than with inhalation anaesthesia.

Perfect muscular relaxation is a decided advantage in abdominal surgery. A smaller incision may be made and less traction is necessary than with inhalation or local anaesthesia.

Contraction of the intestines allows ready inspection of the abdominal viscera and very little packing off is required.

The time allowed by spinal anaesthesia is conducive to more careful work.

No injury to the kidneys occurs with spinal anaesthesia.

The heart is disturbed less than with inhalation anaesthesia.

Gastric disturbances occur in only a small percentage of cases and are then slight and transitory. Liquids may be administered by mouth during and immediately after operation. Nourishment may be given just after the disappearance of the analgesia effect.

Convalescence is shortened and there are few post-operative complications attributable to the anaesthetic. No lasting post-operative effects due to the anaesthetic have occurred in our cases.

Spinal anaesthesia is a safe method as regards danger to life.

In brief, spinal anaesthesia is a method which permits the performance of operative procedures without disturbing the equilibrium of the patient.

#### REFERENCES

- <sup>1</sup> Babcock: Oxford Surgery.
- <sup>2</sup> Labat: Regional Anaesthesia.
- <sup>3</sup> Boyd: The Cerebrospinal Fluid.

# TRANSACTIONS

OF THE

## PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held November 5, 1923*

The President, DR. JOHN H. JOPSON, in the Chair

### TREATMENT OF ACUTE TRAUMATIC SYNOVITIS

DR. HUBLEY R. OWEN said that during the past year, since reading the article by Williams which appeared in December, 1922, on the effect in the treatment of acute traumatic synovitis, of repeated aspirations and immediate active mobilization, without splinting, he had treated eleven cases by the method described. Such cases, presenting hæmarthrosis and hydrarthrosis, are usually treated by rest, splints, plaster-of-Paris, etc. In the recent cases which he had subjected to aspirations he had found the period of disability to be greatly diminished, practically to two-thirds of the time it would take by the fixation and plaster-of-Paris treatment. It also greatly relieves the immediate pain and the distention in the joint. He aspirated twenty-two times and the average time of treatment was twenty-four days from time treatment was started until the man was back on duty. In looking up similar cases treated by the fixation method, he found the aspiration method took just about two-thirds as long.

### PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

DR. J. W. BRANSFIELD presented a youth, aged eighteen years, who was admitted to St. Agnes' Hospital, July 8, 1923, complaining of difficulty in breathing and pain in left chest. Two days before admission he was stabbed with sharp pointed scissors in left chest. States he has had shortness of breath since this accident and severe pain on breathing. Examination shows an abscess over the ninth rib in the nipple line. Patient is very nervous and irritable and complains of pain wherever he is touched. During the following day abscess opened. Two ounces of pus evacuated. Patient feels better, but shortness of breath continues. Dulness found from seventh rib to base of lung in axilla. X-ray report: Pericardial shadow enlarged. Has appearance of fluid present. Diaphragm moves freely on both sides—erosion of bone tenth cartilage.

On July 16, under local anaesthesia, the fourth rib was resected close to sternum—pericardium opened and only one ounce of fluid obtained—fluid cultured—staphylococcus aureus reported from the laboratory. Patient sent to X-ray—fluoroscope made and stereoscopic plates. No doubt of fact pericardium greatly distended. Fluid was suspected lower and posterior so under a general anaesthetic the fifth and

sixth cartilages were resected, the pericardium was brought up into the wound and incised. About one-half pint of fluid escaped. Culture showed staphylococcus aureus again. Patient was dressed daily and the opening maintained. Drainage was continued for two weeks. The pericardium was irrigated with normal salt solution daily. After this the wound was dressed with Dakin's oil and one ounce of oil was poured into the pericardial sac. Convalescence was stormy because the patient was hard to manage. Temperature varied from 100 to 104 for the first three weeks. After the fourth week the temperature became normal and the patient was allowed out of bed after the fifth week. Examinations made of the patient since, at three weeks' intervals have failed to reveal any heart disturbance. The patient has no cardiac involvement and is able to do his regular work. Recent X-ray pictures show the pericardial sac of normal size.

DR. JOHN B. ROBERTS remarked that in suppurative pericarditis it is generally unnecessary to excise the costal cartilages. The same thing is true in pleural suppuration. A horizontal incision in the fourth or fifth interspace will usually afford room for drainage and irrigation without cutting away a rib or costal section. Even in young children resection must rarely be necessary. The vertical incision of Pool is perhaps occasionally required, but the accompanying removal of cartilage requires more time and is more serious. With a good open incision between ribs one can push the pleura to one side by blunt dissection. Of course when pus is coming out of the pericardium, one can understand the fear of pus escaping into the pleural sac, but just as good work can usually be done without mutilating the cartilages as is done in the vertical para-sternal cut.

As to the X-ray diagnosis of pericardial effusions, he related an experience at the Polyclinic Hospital a few years previously when a child, seven and one-half years of age, was admitted and declared to have a large effusion. The X-ray showed definitely, it was declared, that there was an extensive effusion in the pericardium, confirming the diagnosis made by the paediatrician. Doctor McKnight punctured between the xiphoid and seventh cartilage with an ordinary aspirating needle and obtained no fluid. An incision in the fourth interspace of about three inches long between the cartilages of the ribs enabled him to introduce a finger into the pericardial sac, where he found no fluid, but only a large hypertrophied heart. The X-ray diagnosis was incorrect as was the clinical diagnosis made at first, namely, effusion, as there was none present. This seems to show that one must not take the laboratory findings as final, even of the best men. One must also obtain a careful history and translate the clinical symptoms.

After operation, the child immediately began to improve. The revised diagnosis of valvular disease and secondary hypertrophy led to a change in medical treatment. The splitting of the pericardium, by giving the enlarged heart room, probably was an additional reason for this improvement. The child got practically well and had his tonsils removed before leaving the

## PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

hospital. A subsequent report showed him running around and in fair health. No harm had come from either aspiration or the correction of the diagnosis by freely opening the pericardium for revising the diagnosis of the exact pathological condition. The horizontal incision in the fifth or sixth interspace gives plenty of room for introducing the finger. The division of the internal mammary vessels may easily be controlled by clamping with a hæmostatic forceps, which in this case was left protruding from the wound for a couple of days.

DR. D. L. DESPARD remarked concerning the taking away of one cartilage that in his case he found that the pleura was not confined to the anatomical description given in the text-books but came well over to the sternal line. However, this particular pleura had fluid in it and if he had gone through one incision he would have gone through the pleura and infected it. There is better control by the vertical incision of the anatomical relations and he did not believe there is serious disadvantage in the more extensive removal of the cartilages.

DOCTOR DESPARD then presented a heart removed from a man on whom he operated last summer with a history that he had been taken ill three months prior to admission to the hospital with bronchitis or bronchopneumonia. He was in bed for one week and then went back to work, but after three days had to give up his position and did not work again up until his admission to the hospital two and one-half months afterwards. The X-ray showed tremendous dilatation of the pericardium. He was operated on under local anaesthesia. The pericardium was opened and drained and Dakin's tubes inserted in place. Two or three days later his temperature began to go up and he got gradually worse and died. The autopsy showed: First, chronic suppurative pericarditis; second, old operative wound; third, chronic adhesive pleuritis, bilateral; fourth, general pulmonary tuberculosis; fifth, tuberculous lymphadenitis, peribronchial; sixth, parenchymatous degeneration of the liver; seventh, chronic diffuse nephritis.

The incision was from above at the fourth cartilage and the left side of the sternum, and downward along the left side of the sternum to the seventh costal cartilage, removing fifth, sixth and seventh costal cartilages under local anaesthesia. Exposure was good. Tube placed to the bottom of the sac. The man did not seem to mind the operation and stated that "anyone could stand the operation."

DR. JOHN H. JOPSON said that Pool's argument in favor of the resection of the fifth, sixth and seventh cartilages was that in this way one could reach the bottom of the sac with Dakin's solution, and it would not accumulate. He had had one case in which he used the old-fashioned method of resecting only one costal cartilage and found that the administration of Dakin's solution was not very successful. The fluid puddled too much. In similar cases he would use the vertical incision and in this case one should remove the fourth, fifth and sixth, or the fifth, sixth and seventh cartilages to get down to the base of the pericardium.

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INTRA-ABDOMINAL HEMORRHAGE FROM RUPTURED  
CORPUS LUTEUM

DR. DAMON B. PFEIFFER related the history of a girl aged fifteen and one-half years, who was awakened at 2 A.M. by severe abdominal pain. The pain was general and continued with but little abatement during the night and the following morning. The pain did not distinctly localize except that it seemed to be chiefly in the lower abdomen. This was the first attack of the kind. She had always been healthy and had had no digestive disturbances. She had begun to menstruate two years previously, had always been regular, the periods lasting four to five days and being normal in character. The last period was as usual, two weeks before the present attack.

On admission to the Abington Hospital, February 14, 1923, she appeared rather pale, but she was a pronounced blonde and her skin was usually white. The conjunctiva was not markedly blanched. General examination was negative. The temperature was 97, the pulse 72, and respirations 20 per minute. She still complained of abdominal pain. The abdomen was moderately distended and there was tenderness and moderate rigidity in the right lower quadrant and, to some extent, on the left side over the pelvis. The leucocyte count was 17,600.

She had been very active and athletic, engaging strenuously in basketball. Several days previously she had been knocked over a chair, striking her abdomen violently but the resulting pain soon stopped. The evening of the attack she attended a dance but had no pain, and was in bed at 12 o'clock. No pelvic examination was made because of her age and the absence of symptoms pointing in that direction.

At operation as soon as the peritoneum was reached the blue color betrayed the presence of blood. On incising the membrane fluid blood poured out in abundance. The right ovary appeared slightly larger than normal and on its convex border there was an irregular rupture about .5 cm. in diameter, exposing the interior of a small cyst from which blood was slowly oozing. The left tube and ovary were examined and found normal. As the cyst did not appear enucleable the ovary was removed. The appendix was amputated. Clots in the pelvis were withdrawn by hand and the abdomen closed without removing the bulk of the fluid blood, estimated to be about a litre.

Recovery was uneventful. The blood count the day after operation was: Hæmoglobin 80 per cent., red blood cells, 4,090,000, white blood cells 12,200; on February 26th the blood count was: Hæmoglobin 89 per cent., red blood cells 4,580,000, white blood cells 7100. Her health has been perfect and menstruation normal since leaving the hospital.

Microscopical examination of the ovary showed a cyst about .2 cm. in diameter after hardening and preparation, the lining of which was made up of lutein cells undergoing retrogressive changes. This mantle of cells varied greatly in thickness, being thinnest on the convex border near the point of rupture. Beneath the theca there were a number of interstitial hemorrhages. The ovarian stroma appeared rather loose and œdematous and in some areas there were a few scattered lymphoid cells, but not sufficient to justify the diagnosis of chronic inflammation.



## INTRA-ABDOMINAL HEMORRHAGE

The reporter added that this is a rare accident although its existence has been known ever since Scanzoni in 1845 reported the case of a young girl aged eighteen who died of hemorrhage from rupture of a small ovarian cyst, the abdomen containing six pints of blood. In the absence of a microscopical examination, some doubt has been cast on this case as being probably an instance of ovarian pregnancy. However, since that time a considerable number of authentic and thoroughly studied cases have been put on record and it has been proved that grave and even fatal hemorrhage may occur as a result of rupture of an ovarian cyst in the absence of pregnancy. Von Beust in Germany, Jayle in France, Novak, Richard Smith and Bovee in this country, have made the most complete studies and collective reports of the condition.

Ovarian hæmatomata are of four varieties. (1) Interstitial, in which hemorrhage occurs into the stroma, a rare variety and probably not productive of massive intra-abdominal hemorrhage by rupture. (2) Follicular, which are sub-divided again into (a) Graafian follicle cysts and (b) atretic follicle cysts. It is well established that hemorrhage may occur into cysts of this variety and occasionally by subsequent rupture give rise to intra-peritoneal hemorrhage. Collective reports seem to show that the more common variety is that of hemorrhage from atretic follicles. (3) Corpus luteum hæmatomata—are relatively common findings in the ovary. The vascularity of the corpus luteum and the delicacy of its lining membrane would appear to predispose to hemorrhage into its interior. Occasionally the wall of the cyst itself ruptures during the stage of involution, followed by outpouring of more or less blood into the abdominal cavity. (4) The fourth variety of blood-containing cysts of the ovary is that which has recently been so brilliantly elucidated by Sampson of Albany, namely, "The Perforative Hemorrhagic Cyst of the Ovary," which he has shown to be adenomas of the endometrium. These structures are in reality ectopic uteri and their contents are the result of menstruation carried on by the endometrial lining. They have long been known as chocolate cysts on account of the color of their contents and Sampson has pointed out their peculiarity of discharging at the height of the menstrual cycle bits of their adenomatous lining which have the power to engraft themselves on the peritoneum, thereby giving rise to secondary adenomas of similar behavior. No such cyst has been connected with massive intraperitoneal hemorrhage as yet, though there is no apparent reason why their penchant for rupture should not occasionally be the starting-point for hemorrhage of some magnitude.

Most of these cases have come to operation under the diagnosis of acute appendicitis. While it is quite possible that the great majority would recover without operation, the extreme difficulty of making a positive diagnosis without operation and the danger of overlooking a more serious condition make expectant treatment inadvisable. Treatment consists in either resection of the cyst or removal of the ovary. It is important to recognize the fact

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that massive abdominal hemorrhage may arise from the ovary independent of ectopic pregnancy.

DOCTOR MULLER said that he could recall four or five cases in which there had been diagnosed a rather mild type of appendicitis and in which small clots of blood were found in the pelvis without any disease of the appendix. They might have been cases of corpus luteum origin. He also related the history of a woman who had symptoms of extrauterine pregnancy and was operated on in March, 1910, and the right tube removed for extrauterine pregnancy. In October, of the same year, she had the same symptoms, etc., and the same diagnosis was made by her physician. At operation the tube was found normal but the ovary showed a small perforation and there were three or four ounces of blood in the pelvis. The ovary was twisted and although they searched for it they could find no evidence of pregnancy in the ovarian tissues. Ten years later he removed the left ovary for a cyst five or six inches in diameter, showing that probably the original diagnosis should have been cyst.

#### TREATMENT OF FRACTURES OF THE SKULL

DR. HENRY P. BROWN then read a paper with the above title, based upon one hundred cases observed at the Pennsylvania Hospital. Dr. Edward A. Strecker had collaborated with him in the preparation of this memoir. For this paper, see page 198.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting Held October 24, 1923*

The President, DR. EUGENE H. POOL, in the Chair

### CARCINOMA OF STOMACH

DR. ALLEN O. WHIPPLE presented a man, forty-five years of age, who for two years had suffered from attacks of vomiting, of gradually increasing frequency—vomitus—mucus and green colored, but never any blood or coffee-ground material. There was no loss of appetite nor marked loss of weight, nor absence of free HCl. He has had gradually increasing pain. He was admitted to the Presbyterian Hospital in December, 1920.

Test meals show pyloric obstruction, free HCl and no lactic. These facts, together with his florid color, lack of cachectic look and his generally good condition in presence of pyloric obstruction, suggested a pyloric ulcer causing obstruction.

*Operation, December 28, 1920.*—Pylorectomy: Gastro-enterostomy, Polya-Balfour method.

Situated in the pylorus and occupying the upper and posterior half of the pylorus was an indurated mass causing partial obstruction. The mass measured approximately three centimetres in diameter. The serous surface showed one or two whitish plaques but otherwise the mass did not have the appearance of carcinoma. Lymph-nodes were not enlarged along the lesser or greater curvatures—only one or two small nodes were felt, below the pylorus between the duodenum and pancreas. No masses were noted in the gastro-hepatic omentum or in the liver. Inasmuch as the pylorus was not adherent to any structure, pylorectomy was indicated. The pylorus and a portion of the stomach a distance of 6 cm. from the pylorus was excised and then a loop of jejunum some 15 to 16 inches from the duodeno-jejunal angle was brought up in front of the colon and a side-to-end anastomosis was made between the anti-mesenteric border of the jejunum and the cut end of the stomach. This was done by serous peritoneal suture of shoemaker stitch changed to inverting Connel stitch with a continuation of the serous suture. Chromic was used throughout. The upper end of the jejunum was tacked to the gastro-hepatic omentum to prevent angulation of the upper end of the anastomosis. The pathological diagnosis of carcinoma of stomach was established.

Partial obstruction followed the operation but was somewhat relieved by giving him small meals more frequently. He gained weight and his emaciation noticeably improved.

DOCTOR WHIPPLE presented a second case, a man aged sixty years, occupation laborer, who until one year before coming to the hospital had never been seriously ill. One year before admission he began to have epigastric distress after meals, 1 to 3 hours p.c. This distress was never severe, and was usually relieved by taking food. During the year he had vomited three times, never any great amount, and vomitus never contained blood or coffee-ground material. He had good appetite, had not lost weight and had no asthenia. Gastric analysis on three tests showed no free HCl. Trace of blood in both fasting and test meal contents. Barium fluoroscopy and X-rays showed a constant and large deformity on greater curvature of stomach, extending half-way through the stomach, showing absence of peristaltic wave. No six-hour retention.

At operation, March 19, 1921, corresponding to the incisure seen in the X-ray was found a dense hard mass, infiltrating the walls of the stomach. Lymph-nodes in lower part of the lesser part of the lesser curvature were enlarged, as were two near the site of deformity in the greater curvature. The stomach felt entirely free of pancreatic attachment, but after the duodenum had been severed and pylorus turned back, it was found that there was an attachment of the mass to the mesocolon, requiring the excision of a section of mesentery near the midcolic vessels. No liver involvement was found.

Partial gastrectomy was done, with gastro-jejunostomy, side of jejunum to end of stomach, jejuno-jejunostomy, Moynihan technic.

He made a very smooth convalescence. No vomiting, but it was evident he had a lessened stomach capacity below the average. Weight on leaving the hospital, 131 pounds. Two months follow-up, 143 pounds. No gastric symptoms. Nine months follow-up, 146 pounds. No gastric symptoms. Twenty-two months follow-up, 143 pounds. Shows beginning epigastric hernia.

DR. GEORGE WOOLSEY referred to a recent case of a Polya-Balfour resection of the stomach for carcinoma, where he was compelled subsequently to add jejuno-jejunostomy. He agreed with Doctor Whipple that jejuno-jejunostomy was often a wise procedure to add to the anterior operation. He was inclined, if conditions were favorable, to do a posterior gastro-enterostomy, but where there was some special reason for an anterior gastro-enterostomy the jejuno-jejunostomy was often a wise proceeding.

DR. NATHAN W. GREEN said that cases of carcinoma of the stomach at the Memorial Hospital in the last three years—approximately 100, had been seen by him. They had come so late for treatment that little could be done for them. The point of value was that he was able to go into the histories formulating the symptoms of carcinoma of the stomach. It seemed to him that a large number of them gave a history chiefly of weakness. They did not stress the anorexia nor was the loss of weight always predominant, but the weakness was a main feature. Some of these stomachs had been resected before going to him, one, three and one-half years previously. This had a good-sized recurrence. This showed they might go on for quite

## POLYSEROSITIS

a while without obstruction; yet, what might seem a cure at the end of three years might show a palpable growth again at the end of three and one-half years. Doctor Green had been struck with the incidence of bad teeth; pyorrhœa was almost universally present in these cases.

DOCTOR WHIPPLE said that there was a point which he had intended to bring out in regard to the two cases. Many of these patients with upper abdominal incisions, especially with post-operative pulmonary complications, have a tendency to hernia, and this tendency has been eliminated in the past two years by using silkworm gut sutures on pearl buttons, a procedure first indicated in Doctor Bevan's clinic in Chicago. These tension sutures can be left in, twelve to fourteen days without the pressure necrosis which accompanies the use of silkworm gut sutures without buttons.

## POLYSEROSITIS

DR. CHARLES E. FARR presented a man, thirty-three years of age, who was in the New York Hospital, service of Doctor Gibson, from July 9 to 19, 1923, for acute intestinal obstruction, and chronic general peritonitis. He had been operated upon one and one-quarter years previously for appendicitis; this had been followed by left phlebitis, left leg and foot swollen. He had been suffering for four hours with severe pain and nausea and had had some constipation and indigestion with some vomiting for the previous two weeks. Physical examination showed a rigid, tender abdomen, especially in the epigastric region. The abdomen was opened through the right rectus. Extreme obliteration of the peritoneal cavity was seen. The liver, gall-bladder, stomach and large bowel were in one dense mass of adhesions which were partially freed but with difficulty. No other lesion was found here. In the lower central abdomen a small, free peritoneal cavity, about 5 inches in diameter, was entered. In this lay a sausage-shaped mass, at first mistaken for a mesenteric cyst. It was partly delivered and proved to be the entire ileum tucked into a skin-like covering, not unlike a sausage skin. This was split, partly resected and the loop of bowel freed with great difficulty. The whole operation was difficult and lasted about one hour. No drainage was used. Post-operative recovery was uneventful, although an absolutely bad prognosis had been given.

All clinical tests for lues or tuberculosis are negative. Improvement has continued. The X-ray with barium meal demonstrates a very fair peristalsis. The röntgenograms of the chest reveal an apparent destruction of the pleural cavities and possibly the pericardium. An attempt at artificial pneumothorax might clear up this point. The official diagnosis from the röntgenologist is tuberculosis of the mediastinal lymph-nodes and infiltration of both upper lobes.

These cases are usually rapidly progressive and prove fatal in a comparatively short time. Further progress in this case will be of great interest. The condition was thoroughly discussed by Charles N. Dowd at a meeting of this Society last spring, and his article in the *ANNALS OF SURGERY* for April, 1923, p. 432, is the most recent and authoritative on the subject.



## NEW YORK SURGICAL SOCIETY

DR. ALLEN O. WHIPPLE spoke of a patient who is now in the Presbyterian Hospital. She was first operated upon four years ago for a condition which was then diagnosed as cirrhosis, considered at that time to be atypical. On opening the abdomen at that time, a considerable amount of fluid was found, and the peritoneum was thickened over the liver and spleen. An omentopexy was done. In the past four years the patient had been tapped twenty-seven times. She came back to the hospital in the early part of the summer, and on introducing a needle through the abdominal wall, it was noted that the fluid removed was purulent and foul smelling. A diagnosis of peritonitis was made, and she was operated upon immediately. The pathology noted at operation was very remarkable. The entire peritoneal cavity was made up of loculated spaces separated by a thin wall of peritoneum containing different types of fluid. In other parts the peritoneum was markedly thickened and showed the pathology of chronic productive peritonitis described by Welsh in 1908. She continued to improve and the sinus is now closed. With such extensive peritoneal inflammation, the function of her digestive apparatus is remarkably good. This further illustrates the lack of absorption in these cases of chronic productive peritonitis. This lack of absorption and good digestive function has been noted by a number of observers in these cases of chronic productive peritonitis.

DR. EDWIN BEER thought there was a question as to whether this was a case of polyserositis for only one membrane was involved. Personally, he thought it should be called chronic productive peritonitis, and unless further information concerning the previous appendicitis was at hand, one could not exclude this as a cause of the productive peritonitis. As for the treatment by X-ray, it was very doubtful whether this would lead to absorption as it usually had the opposite effect within the abdomen.

DOCTOR FARR, in closing the discussion, said that when the appendix was removed the wound had closed primarily; there were many adhesions at that time. He had not cared to inject air into the pleural cavity. There almost surely is a destructive process in pleural sacs. There is no proof of the condition of this patient. The X-raying had been done as a last resort as nothing was being accomplished otherwise. Recent barium meal roentgenograms show a moderate distortion of the stomach with fixation of the pylorus. Emptying time is nearly normal and the passage to the colon seems slightly, if at all, delayed. The ileum throws a nearly normal shadow. There is some fixation of the ascending colon and slight stasis in the jejunum. The patient is slowly gaining in weight and strength.

## SUPPURATIVE ARTHRITIS OF KNEE

DR. CHARLES E. FARR presented three cases of acute suppurative arthritis of the knee, from the service in St. Mary's Free Hospital for Children, all treated by the Willems' method.

CASE I.—Girl of five years with negative family and past history. Present illness was of two weeks' duration, beginning with pain in the

## SUPPURATIVE ARTHRITIS OF KNEE

left knee followed one week later by swelling, redness and stiffness. Cold applications were used, there was fever, but no chills. Examination was negative except for the left knee joint, which was boggy, with free fluid in the joint and œdema over the tibia. Tenderness was marked. Passive motion caused great pain. There was no voluntary motion. The knee was held flexed at  $45^{\circ}$ . The X-ray was negative, throat culture negative, Von Pirquet negative, leucocytes 19,600, polymorphonuclears 90 per cent. Temperature on admission was  $104^{\circ}$ .

Operation was performed by Dr. L. A. Wing, free lateral incisions being used and no drains inserted. Active motion began forty-eight hours later. She was discharged six weeks later, healed, with full range of motion and bearing her weight without pain. Cultures from the knee showed staphylococcus and streptococcus.

CASE II.—Girl of six years. Admitted February 1, 1923, discharged March 11, 1923. Present illness began three days before admission, when the child broke off a portion of a sewing needle in the right knee. Severe pain, swelling and disability were noted the following day. On admission the knee was swollen, extremely tender, and contained fluid. Aspirated fluid was thick pus containing the staphylococcus aureus. X-ray showed the fragment of needle in the posterior pouch of the joint. Temperature  $102^{\circ}$ . Leucocytes 12,800 with 82 per cent. polymorphonuclears. Operation was performed at once, free lateral incisions with no drains inserted. The needle was not removed. Active motion was instituted at once. The knee healed promptly with full range of motion and painless weight bearing.

CASE III.—Girl ten years of age. Present illness began three days before admission with malaise and pain in both knees and the right ankle, with fever. Examination on admission showed a swollen, painful flexed right knee, with extreme tenderness and spasm. The other joints were tender but soon subsided. Temperature ranged from  $105^{\circ}$  to  $101^{\circ}$ . Leucocytes 15,000, 69 per cent., and 17,000 with 80 per cent. polymorphonuclears. An osteomyelitis of the right tibia was diagnosed and relieved by operation. Blood culture gave pure staphylococcus aureus on the fifth day. Improvement was rapid, but on the nineteenth day the temperature rose sharply to  $104^{\circ}$ , the knee became swollen, red, extremely tender, and contained fluid. Operation was performed at once, free lateral incisions evacuating large quantities of thick pus and fibrin masses. Culture was pure staphylococcus aureus. Active motions were begun at once. Progress was slow but persistent. Later a sequestrum from the tibia was removed by Doctor Truesdell. The child is still in the hospital with a small granulating wound over the tibia. She has perfect use of the knee, free range of motion and painless weight bearing.

These three cases illustrate well the modes of infection of the knee-joint. Two probably had general sepsis, one of which developed an osteomyelitis in an adjacent bone and subsequent involvement of the joint by perforation. The other without apparent bone involvement developed an arthritis from the blood stream direct. The third case was due to penetration from without. All three have practically perfect

knees. This is especially noteworthy in that one case still has a foreign body in the joint and a second has an unhealed osteomyelitis of the tibia. All three do great credit to the Willems' method of treating suppurating knee-joints.

DR. EDWARD D. TRUESDELL said that the first case presented by Doctor Farr, which had been under his own care, was acutely sick when admitted to the hospital. Her temperature had fallen to normal one week after drainage of the knee-joint had been established. She was running about the ward four weeks later and had been discharged cured on the fortieth day. His own experience had been in line with Doctor Farr's in that septic joints in children seemed to commonly follow direct injury, some local or general infection, an adjacent osteomyelitis or, more rarely, without satisfactory explanation. He believed that in infants a suppurating joint was a common source of deep suppuration in the extremity involved and was then difficult to distinguish from a primary osteomyelitis. It was also difficult from his experience to forecast the outcome in these cases from the degree of the severity of the symptoms at outset or from the rarity of organism present.

DR. CLARENCE MCWILLIAMS considered these results confirmation of Doctor Willems' theory. He could never forget seeing Willems demonstrating this during the War at a military surgical congress in Paris, on sixteen soldiers, who with infected knees walked about the room with pus squirting out at each step and in perfect general condition and with perfect joint function, and without any temperature. Willems emphasized the fact that active motion compresses the joint by contraction of muscle and hence drains the joint best. Passive motions are never to be employed since one would carry the motions too far and do damage. Active motions are limited to the point where pain is elicited and this is the point at which to stop. Willems carried out active motions every two hours day and night beginning immediately after coming out of the anæsthetic. Rarely has any surgical procedure received such full confirmation as this during the War. All opposition has been silenced. Under the old immobilization treatment these three children would have been doomed to stiff knees instead of having functionally perfect joints. Willems' treatment of joint infections is the outstanding one of two brilliant surgical outcomes of the War, and the second is the Carrel-Dakin treatment of infected wounds.

DR. BURTON J. LEE said that in January, 1920, he read a paper before this Society on the question of active mobilization of suppurating joints, and in gathering his material he had sent out a question to the members of the Society: "To what extent do you use Willems' treatment of mobilization of septic joints?" There were ten replies from surgeons who disapproved of the method. These cases that Doctor Farr had shown of suppurating joints in children are types in whom it is difficult to induce active motion and they are therefore a good demonstration of the results of Willems' treatment. In the two cases of his own in which the speaker had been able to carry out the principle, the result has been highly satisfactory. He felt that the method

## LIVER AND ITS RELATION TO CHRONIC ABDOMINAL INFECTION

was an excellent one, and that it gave results possible by no other means of treatment.

DR. EDWIN BEER said that outside of remarkably good functional results obtained by this method of treatment in a fair proportion of cases, on two occasions he had noticed a very interesting phenomenon which might explain the production of loose cartilaginous bodies in joints. Everyone employing this treatment has noticed that the edges of the non-drained incisions tend to agglutinate, and at times the finger must be introduced into the joint and in the knee into the bursæ to reestablish adequate drainage. In two cases of this sort he had noticed in the synovial membrane small plaques of cartilage which seemed to have formed as a result of the weeks of chronic irritation. Apparently, therefore, it would seem that by some irritants the synovial membrane becomes changed and by metaplasia cartilaginous islands are produced. X-ray may not detect such changes, although at times when extensive and associated with calcification, X-ray pictures may be positive. This interesting observation in this type of case Doctor Beer thought very suggestive and perhaps explanatory of the origin of some "joint mice."

DR. FRANK S. MATHEWS said that he had been impressed with the frequency with which joint infections and osteomyelitis of staphylococcus origin could be traced to a skin infection; he thought in our present interest in tonsils and teeth, that this source of infection had been largely overlooked. In opening infected joints, he has usually made a small opening so as to be able to distend the capsule with irrigating fluid. After washing it out through this opening, the incision has been increased, and second incision made on the opposite side of the joint. He has used the Willems' treatment to a limited extent, as he had never been more than half converted to the wisdom of active early mobilization. It seemed to him more reasonable to assume that after a joint is thoroughly drained, that the question of ankylosis will depend not on early motion, but on the degree of destruction of bone and cartilage.

## THE LIVER AND ITS RELATION TO CHRONIC ABDOMINAL INFECTION

DR. CHARLES GORDON HEYD read a paper with the above title, for which see page 55, *ANNALS OF SURGERY*, January, 1924, vol. lxxix.

DR. WILLY MEYER said that what had principally interested him in the course of the last few years with regard to diseases of the liver and bile system had not been so much the investigation into liver function as that into the fixation of the diagnosis of chronic cholecystitis with or without stones. Every surgeon had often seen macroscopic changes in the liver when operating for chronic gall-bladder disease, such as cicatrices and fibrotic areas in Glisson's capsule, hypertrophy of the liver, bands fixing the convexity of the organ to the diaphragm, etc.

So far, the surgeons in general had not joined hands sufficiently with the pathologists, biochemists and internists doing research work on the liver proper when operating on the bile ducts and the gall-bladder. Doctor

Heyd's procedure of removing a piece of the liver, in such instances, for closer study meant a distinct advance.

The definite etiological fixation of the diagnosis of gall-bladder disease with the help of all the scientific means which are at one's disposal at present, he had worked out in conjunction with Doctor Einhorn by analyzing the contents of the duodenum as they were physiologically expelled into this viscus from the bile system. He was convinced that it was necessary to make this examination in the fasting condition of the patient. At the same time, he was ready to recognize the good work done by Lyon, of Philadelphia; but he believed that the so-called Meltzer-Lyon test is of little value with reference to diagnosing disease of the gall-bladder. It is of great value, however, in therapeutics. In view of the facts brought out in Doctor Heyd's paper the test might recommend itself in adipose patients in whom such sudden death, as described by the reader of the paper, might occur without the surgeon being in the least responsible for its occurrence. The test could be used before the operation, in a prophylactic sense, and the operation could then follow. Testing the function of the kidneys before doing a severe renal operation is now habitual.

With regard to the etiology of gall-bladder infection the speaker said he was inclined to side with Graham, of St. Louis, *viz.*: that the lymphatics carry the infection from the liver to the viscus. Just consider a true case of ptomaine poisoning followed by jaundice. Usually the acute disease, if not too severe, does not last long. There is no acute gastric or duodenal catarrh which would spread upward into the bile system and produce jaundice. It seems to be rather the absorption from the stomach and intestines into the liver which is from there carried to the gall-bladder and bile ducts and is responsible for a subsequent jaundice. Here the modern treatment of whipping the liver into more intensive action, plus emptying the gall-bladder, has done much good.

Doctor Heyd had mentioned three distinct classes of complicating liver affection, which can interfere with normal healing and had also described the best therapy of each of these classes. In order to show the occurrence of still other complications after operations on the bile system, which cannot be laid at the door of the operating surgeon, Doctor Meyer then briefly related the history of a case which has been under his observation within the last year, a lady, forty years of age, the mother of six children, who had had persistent attacks of cholelithiasis. She had shunned surgery out of fear, but at last submitted to cholecystectomy. The gall-bladder, little inflamed, was found to be filled with innumerable small calculi. The operation was not a difficult one and with the usual drainage and closure everything went well. The anæsthesia had been carefully administered by an expert by means of the drop method. The operation was done in the morning and in the evening the patient was in a normal condition. Early the next morning she suddenly went into a profound collapse and a hurry call was sent to Doctor Meyer. He knew that he had ligated the cystic artery separately so there could be no



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secondary hemorrhage; it was too early for acute sepsis. He naturally thought of acute pneumonia, but the anæsthesia had been in the hands of a specialist. On reaching the bedside he found the patient with a pronounced acute pulmonary œdema accompanied by fever, tremendous increase in pulse rate, and scanty and most difficult expectoration of thin mucus with bright red blood. Two hours' work improved the condition, but the patient died twenty-four hours after the operation. Autopsy showed an acute pneumonitis involving the entire right and left lungs except the top of the left upper lobe. Below and around the liver everything was in good order. At the monthly conference of the hospital, after rigid analyzing of the specimens removed, the pathologist pronounced death to be due to a fibrosis of the bundle of His which had produced auricular fibrillation and the acute pneumonitis with pulmonary œdema.

This experience showed what may occur after cholecystectomy when pathologic conditions of the liver, as brought out by Doctor Heyd, are not responsible for a fatal outcome, but a chronic lesion exists in any other important organ which post-operatively determines the issue of the case in hand.

DR. WALTON MARTIN said he had been looking up recently the autopsy records on patients dying after operation on the biliary passages and it was surprising to see how widespread were the lesions: myocarditis, chronic nephritis, aortitis, and endocarditis, as well as degenerative changes in the liver. It would have been difficult in these cases, as in the one Doctor Meyer had just spoken of, to determine the exact cause of clinical conditions preceding death.

DOCTOR HEYD had referred also (a well-recognized point of view) to a frequent association of chronic appendicitis and cholecystitis. The speaker was uncertain often as to the exact meaning of chronic appendicitis. Certainly the completely obliterated appendix could have had little relation to recent infection. It bore, to his mind, about the same relation to an acute process that the scar on a finger did to an antecedent tenosynovitis. As to the very small areas showing low-grade inflammatory signs, he was doubtful if these lesions could furnish toxins to the liver unless the focus was under tension.

Then again, Doctor Heyd had spoken of the theory recently advanced by Evarts Graham regarding the association of hepatitis with cholecystitis, the hepatitis being the usual antecedent condition. Doctor Martin said he felt a certain skepticism regarding the entire acceptance of this point of view. There were of course numerous instances where an acute appendicitis had been followed by an infective portal phlebitis and liver abscess and there were numerous instances where a well-marked suppurative inflammation of the liver had been accompanied by cholecystitis. He recalled the autopsy findings in a case of Doctor Mathews and said he hoped Doctor Mathews would speak of this case. But in autopsy findings in patients dying of acute appendicitis there are usually no signs of suppurative hepatitis and in patients

that recover from cholecystectomy for cholecystitis there is no clinical evidence of a persistent hepatitis. In the follow-up clinic these patients present a most satisfactory group.

DR. FRANK S. MATHEWS referred to two cases of early acute inflammatory changes in the wall of the gall-bladder in which the removal of the gall-bladder did not ameliorate the symptoms; both cases went on to fatal termination and were found at autopsy to be cases of biliary abscess of the liver. The colon bacillus was found in the blood of one of these cases, and the inflammatory exudate in the wall of the gall-bladder seemed to be especially located around the vessels. He had thought of these cases as being more likely blood-borne infection than lymphatic, and that the inflammation of the gall-bladder was simply an incident in a miliary infection of the liver.

DR. FREDERIC W. BANCROFT said that he had had a case of acute cholecystitis with engorgement of the lymphatics in the muscularis and submucosa, which later proved to be due to pyelephlebitis. This started him reviewing his cases of chronic cholecystitis, and he found in these cases, a round-cell infiltration occurs in the muscularis and submucosa often where the mucosa itself is normal. The histology of these cases coincided with Evarts Graham's theory that chronic cholecystitis is due to a lymphangitis secondary to liver involvement. A history analysis of thirty-four cases of chronic cholecystitis without stone showed that 82 per cent. either had had a previous operation for some lower abdominal infection or had a very definite chronically diseased appendix removed at the same time as the cholecystectomy. It will be a real advancement if the liver function can be estimated by phenoltetrachlorophthalin. This test has been estimated by analyses of the stool and by means of the Lyons test, but both of these methods are cumbersome and inaccurate. Recently Rosenthal has proposed a method by blood analysis. If this proves practical it will be a great advantage. The speaker asked Doctor Heyd if he had seen any liver collapse cases following sudden release of pressure in the common duct, where there is jaundice and often white bile. Recent literature by Judd and others has suggested the advisability of intermittent drainage of these cases, clamping the tube for a period of time and then allowing a short period of drainage. In a recent case of his own, this method seemed to be of a distinct clinical advantage.

DOCTOR HEYD said that he agreed entirely with Doctor Martin. The clinical groups that he had drawn attention to were not the cause of the mortality in gall-bladder disease, but they were the exceptional, unexplained causes of some mortalities. When he used the term chronic appendix he was using it in the pathologic sense only and construed a chronic appendix as one that showed either partial or complete obliteration. He thought the appendix was quite as capable of chronic infectivity as was an apical abscess of the tooth and that it was well to remember that when there was a focal infection there might be any one or all of three types of symptoms, local with symptoms confined to the immediate area, secondly, remote symptoms represented in injury to the reno-cardiovascular system, and thirdly, constitutional symptoms in the shape of asthenia, loss of weight and so on. From

## LYMPHŒDEMA OF ARM

a pathologic point of view varying degrees of hepatitis had been found in practically all cases of chronic abdominal infection. In the majority of cases these liver changes were without symptoms. It was well to remember that in a very great number of cases of laparotomies there were combined lesions. The general post-mortem rate for disease of the appendix was about 17 per cent. In general abdominal surgery it was about 23 per cent., while in disease of the gall-bladder and stomach we found a pathologic appendix in from 50 to 60 per cent. of all the cases submitted to surgery. In so far as white bile was concerned, it only represented a mucosal secretion and was associated with an immediate increase in the operative mortality, but was not a factor in late mortalities after biliary drainage had been established. The reason why there are so few symptoms in rather widespread disease of the liver is due to the fact that nineteen-twentieths of the liver can be put out of commission yet the remaining one-twentieth will carry on the work in a more or less adequate manner because symptoms are not produced.

*Stated Meeting Held November 14, 1923*

The Vice-President, DR. WALTON MARTIN, in the Chair

### LYMPHŒDEMA OF ARM

DR. JOHN DOUGLAS presented a large-framed muscular man, forty-five years old, who about five years ago suddenly and with no known cause, while leaning forward to lace his shoe, noticed the back of his right hand began to swell. The swelling extended upward throughout the entire upper extremity and in four or five days the whole arm, forearm and hand had attained a diameter of twice the normal. There was no history of any injury. There was no pain or change in color of the extremity. The only previous history of any possible relevance was that of lues and gonorrhœa fifteen years before, and the fact that he had had a skin wound which became infected and was slow in healing twelve years previously. A year ago he had a positive Wassermann and received treatment. It is now negative.

On admission to Bellevue Hospital, June 2, 1923, examination showed the right arm to be much swollen and œdematous, although the swollen area did not "pit" like ordinary œdema. The swelling was most marked just above the inner aspect of the elbow where it resembled a large lipoma. It was noticeable that the verrucous skin condition present in old cases of elephantiasis of the leg was not present. The veins over the right shoulder and pectoral region seemed somewhat dilated, but this condition was not present in the arm. The pupils reacted sluggishly to light and the left pupil was somewhat irregular. Knee jerks present but diminished.

Radiographic examination showed enlargement of the left ventricle with widening of the aortic arch. No evidence of pulmonary pathology.

There was nothing abnormal in the laboratory examination. A diagnosis of lymphœdema of the arm of undetermined etiology was made and a Kondolón operation advised.

The operation was performed on July 12, 1923, but as the patient's right arm was the part affected, and as the condition present was not

sufficient to prevent his ability to carry on his occupation as an electrical lineman, it was deemed wisest not to risk a complete Kondoléon operation, but to attack the most swollen portion above the elbow, on the theory that this could at least do no harm, and that a sufficient anastomosis might be established between the deep and superficial lymphatics to even reduce the swelling below the elbow as well as the area attacked.

An ellipse of skin 17 cm. long and 3 cm. in width at its widest part, with the underlying subcutaneous fat and fascia somewhat wider, was removed from the inner aspect of the arm just above the elbow down to the anterior brachial muscles in front and the triceps behind. The fat in this area was very cedematous and the connective-tissue separating the lobules thickened and white in appearance. The deep fascia over the muscles was also much changed in appearance, being greatly thickened, white and glistening. It was of interest to observe that the fat and muscle below the deep fascia were not cedematous and did not show this connective-tissue infiltration.

While the etiology of the lesion in the case reported is obscure, the cause of the condition in the case reports of Matas, Sistrunk, Royster, Hill and others, were variously stated as repeated erysipelalous attacks, following a vaccination wound, lymphœdema following removal of the breast and axillary glands for tumor, an injury to the arm two years previously, tuberculosis of the inguinal lymph-nodes, a possibly congenital case (Sistrunk). No etiological factor except possible septic tonsils, an attack of arthritis and furunculosis. In none of the cases reported was the *filaria sanguinis hominis* reported, and attention has been called in the published articles to the necessity as an etiological factor of an infection, usually of the streptococcus type, in addition to the lymphatic obstruction. The rarity of elephantiasis due to filariasis in this country has also been remarked.

Matas states that the histo-pathological elements that are essential to complete the picture of elephantiasis are: (1) A mechanical obstruction or blockade of the veins and lymphatics of the affected region, usually an obstructive thrombophlebitis. (2) Hyperplasia of the collagenous connective tissue of the hypoderm. (3) Gradual disappearance of the elastic fibres of the skin. (4) The existence of a coagulable dropsy or hard lymphœdema. (5) A chronic reticular lymphangitis caused by secondary and repeated invasions of pathogenic microorganisms of the streptococcic type.

The speaker had, however, within the past year seen two cases at the Knickerbocker Hospital of lymphœdema of the leg which had not, it is true, reached the stage of true elephantiasis, but in which no evidence of more than the lymphatic obstruction stage was present. One in a young woman from Porto Rico with enlarged inguinal glands on both sides, the *filaria* being present in large numbers in the blood. The other in the leg below the knee in a woman on whom a transverse incision had been made to suture a ruptured ligamentum patella. In neither case was there any evidence of infection by pyogenic bacteria.

In the series of cases reported by Sistrunk in 1918, although cultures were made from the tissues removed, no growth was obtained. Streptococci, however, were grown from the verrucous formations which were

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present on the arm of the patient who developed elephantiasis, following the infected vaccination. In the case herewith reported staphylococcus albus was reported from culture of the subcutaneous tissue removed. Probably a contamination.

The condition of this patient has greatly improved and he states that the swelling of the forearm, as well as of the arm, has diminished markedly 12 to 14 inches above the elbow and 3 to 4 inches in the forearm. The arm is, however, still swollen and far from normal and the problem now presented is whether further operation this time below the elbow should be performed. The results of the Kondoléon operation have not all been uniformly good and the suggestion has been made that these cases be treated by antistreptococcus serum or vaccines as suggested as a post-operative treatment by Matas and carried out by Sistrunk in his cases.

DR. ALEXIS V. MOSCHCOWITZ said that he had done the Kondoléon operation in a few cases, one within the last six weeks. He had done it mostly upon the recommendation of others and his results had been only fair. He could not remember where he got it in the literature, but the operation as he carries it out was somewhat different from the one done by Doctor Douglas. Doctor Moschcowitz incises the tissues and carries the incision down to the fascia; from this fascia he makes a quadrilateral flap which he buries into the depth of the muscle and to the bone and sutures it there. He does not know whether he was right or wrong. In the last case done, an excision of the tissues would not have been feasible and he is sure that he would have had difficulty in suturing the wound together. He will try to present this patient at some future meeting.

DOCTOR DOUGLAS replied that he had not read the original report of the Kondoléon operation, but the method he followed was from Sistrunk's article published in the *Journal of the American Medical Association* in 1918. He stated that this operation was developed by Kondoléon from two previous suggestions by other operators. In 1908, Handley suggested his method of placing long strands of silk in the subcutaneous tissues with the idea of having these strands act as setons in case of lymphœdema. Later in 1911, Lanz made a long incision in the thigh, exposing the bone, which was trephined at several points, and strips of fascia carried down through the muscles and inserted in the openings previously made in the bone. Kondoléon developed these thoughts and improved on them, depending on the idea that by removing the deep fascia, the obstruction caused by the blocking of the superficial lymphatics would be carried off through the deeper lymphatic vessels lying below the fascia. In Doctor Douglas' case it was noticeable that the deep tissues were not cedematous while the superficial were.

## EXCISION OF RETROPERITONEAL ANGIOSARCOMA

DR. HAROLD NEUHOF presented a woman, twenty-seven years of age, who was admitted to Mount Sinai Hospital, December 20, 1922. Three years before, patient had a single brisk hemoptysis, but the examination for tuberculosis was negative. One year later an appendectomy was done for persistent abdominal pain, diagnosed as chronic appendi-



citis. The patient was then well until about three weeks before admission. She then began to have a sensation of fullness in the abdomen after meals, regardless of the amount of nourishment that was taken. Loss of weight was also noted, estimated to be fifteen pounds. There were no other symptoms.

About twenty hours prior to admission there was the sudden onset of violent colicky pains on the right side of the abdomen, vomiting, and great prostration. Bowels moved after a cathartic and enemata. Pains recurred at frequent intervals and vomiting was twice repeated. There was no fever. When first seen by the reporter about three hours before she arrived at the hospital, she was in collapse, pale, with a small rapid pulse, but no elevation of temperature. Examination of the abdomen disclosed a visibly bulging large mass on the right side, pushing the umbilicus to the left. The right rectus was spastic, and there was rebound tenderness. The mass was tender, slightly movable, tense, and cystic, occupied all of the midportion of the right half of the abdomen, but was not ballotable into the flank. It appeared to be globular, measuring about five inches in each diameter. Three hours later, the mass had greatly increased in size, extending well over to the left of the median line, fixed, measuring about eight inches in the transverse diameter. The patient had suffered two severe chills, but the temperature was normal. The white blood count was 21,200, with 80 per cent. polymorphonuclears.

Operation was immediately proceeded with, for it was evident that a progressive hemorrhage was going on. Upon opening the abdomen through a right rectus muscle-splitting incision, an enormous bluish mass, covered by some greatly dilated veins, at once presented. The transverse colon was displaced below it and the mass appeared to be in the transverse mesocolon. Its limits were ill-defined, the hand reaching to the left to get around the tumor, coming in contact with the spleen, and to the right, with the right kidney. Dilated overlying veins were tied off, the transverse mesocolon was split, and the mass could then be interpreted as retroperitoneal in origin. Enucleation of the mass seeming indicated, the layers of overlying connective-tissue were separated until a plane of cleavage was found and a suggestion of capsule was encountered that appeared to hold the blood mass together. The median colic vessels were identified, one branch ligated, the main trunks retracted to the left, and blunt dissection continued to the left and around to the posterior aspect of the mass. It was then found to be in juxtaposition to, but not derived, from the pancreas. After its posterior surface was partly freed, the mass could be partly delivered out of the abdomen for the first time. Upon gentle traction it was seen that the right kidney was partly drawn into the wound. Dissection was therefore continued on the right lateral aspect of the blood mass, the third portion of the duodenum, intimately related to its posterior surface, was freed, and the mass was then found to narrow down to a readily identified pedicle attached to the upper pole of the kidney. The kidney was apparently normal in size and consistency and the pedicle of the mass appeared to cap rather than to involve the upper pole. Not being certain of this, however, he resected the upper pole of the kidney,

## THYROID TUBERCULOSIS

using mattress sutures, and removed the kidney pole with the blood clot mass in one piece. The posterior peritoneum was closed about a gauze and rubber dam drain placed into the retroperitoneal space, and the abdominal wall in layers.

The specimen was a spherical mass about 7 inches in each diameter with a thin confining membrane holding the blood clot together. Upon section recent and older blood clot and considerable fluid blood was found. Scattered throughout the blood clot, but with some uniformity of distribution towards the periphery, were tumor masses of grayish-yellow color suggesting hypernephroma. The microscopic report was angiosarcoma, the resected portion of the kidney being free from any evidence of invasion by the neoplasm.

The operation was a shocking one and subcutaneous infusions were necessary for the first two days after operation. Thereafter convalescence was uneventful until two weeks after operation. Sudden pain in the right chest and shoulder then appeared, the physical examination and X-ray picture disclosing the existence of a pneumothorax from an unknown cause. This cleared up without treatment. The wound healed by primary union about the drain and the patient was discharged, symptom-free, three weeks after operation.

One month later a series of deep X-ray treatments over the abdomen was given. Recently the patient was readmitted to the hospital for examination for the existence of recurrence or metastases. Cystoscopy, abdominal examination, X-ray examinations of the gastro-intestinal tract, chest, long bones, were all negative.

It is now eleven months since operation. The patient feels well, has gained 30 pounds, and remains free from any evidence of recurrence.

In the absence of any trace of adrenal tissue in the numerous sections taken for microscopic examination this retroperitoneal angiosarcoma cannot be definitely classified as derived from the right adrenal. Its anatomical situation, the freedom from tumor involvement of the upper pole of the kidney to which the growth was loosely attached, the manner in which the neoplasm capped the upper pole of the kidney, and the active hemorrhage, all suggest a tumor of the kidney. This viewpoint is supported by a few cases of adrenal tumor proven by autopsy examination, in which the microscopic examination showed angiosarcoma without any trace of adrenal elements. It is therefore not necessary to find adrenal tissue, or a hypernephroma, or a tumor, composed of nervous tissues in order to establish the diagnosis of an adrenal malignancy.

## THYROID TUBERCULOSIS

DR. HAROLD NEUHOF presented a woman, thirty-five years old, who was admitted to Mount Sinai Hospital, service of Doctor Elsborg, September 1, 1923. Her previous history is not relevant. One year ago she was treated for a moderately severe typhoid fever, since which time there have been periodical attacks of hemicrania. Four weeks before admission to the hospital the patient first noted a swelling on the left side of the neck, attention to which was drawn by pain. A similar painful swelling was noticed shortly thereafter on the right side

of the neck. Inspiratory dyspnea developed, together with some difficulty in swallowing. No symptoms referable to hyperthyroidism appeared. When the patient was seen about a week before admission to the hospital, a hard irregular mass was found in the lower part of the neck, which had increased perceptibly in size when she was next seen in the hospital.

The general physical examination of this well-nourished patient was negative and the basal metabolism was normal. There was an area of increased dullness to percussion over the upper portion of the manubrium sterni. The mass on the neck was a median, firm, irregular tumor the shape of which did not suggest thyroid. Its transverse diameter was about 10 cm., extending more to the left than to the right of the median line, and the vertical measurement about 7 cm. The mass lay deep in the neck in the suprasternal region, its lower border not being palpable because it extended into the mediastinum. The mass moved with swallowing and appeared to hug the trachea. The ante-operative diagnosis was a malignant neoplasm attached to the trachea, possibly a substernal thyroid.

At operation the thyroid gland was found to be the seat of a firm tumor of rubbery consistency, projecting into the superior mediastinum, especially on the right side. The gland was enlarged two to three times the normal, irregular on its anterior surface, with projecting rounded nodules on its deep surface. The overlying and adjacent musculature was loosely attached to the surface of the tumor. The trachea was closely gripped by the neoplasm, to which it was attached by fibrous tissue in which no plane of cleavage could be found. Similar fibrous tissue fixed the deep surface of the thyroid tumor to the underlying structures. Attached at the thyroid axis on the left side was a firm nodule not connected with the thyroid tumor and interpreted as a metastasis.

The tumor was exposed through a low collar incision. Complete thyroidectomy was rendered difficult by the low and deep situation of the tumor, its consistency rendering impossible, the delivery of the lobes out of the wound, and the necessity for sharp dissection on the posterior surface of the neoplasm. In freeing the right lower pole of the tumor the pleura was exposed, but apparently not injured. The vessels were tied off on both sides beyond the neoplasm. Detachment of the tumor from the trachea could only be accomplished after both lobes had been freed. It was then carried out by sharp dissection laying bare four or five rings of the trachea. The wound was closed in layers, two tubes placed in the dead spaces.

Directly after operation, which was of an hour's duration, the patient's color became dusky, there was progressive respiratory embarrassment, and the picture was one of rapidly advancing tracheal obstruction. The midportion of the wound was therefore opened and the trachea exposed. No collapse of the trachea was noted. It was nevertheless opened, with the escape of considerable blood and bloody mucus, the evident cause of the obstruction. A tracheal canula was introduced, surrounded by gauze packings.

After the first day the patient progressed satisfactorily. She was

#### TUBERCULOSIS OF THYROID GLAND

placed on thyroid extract on the second day after operation. The tracheotomy tube was removed on the third day. Hoarseness of voice was noted and the laryngological examination disclosed paralysis of the right vocal cord. The wound healed rapidly about the tracheal opening, and the patient was discharged three weeks after operation with a superficial granulating wound.

About three weeks ago the patient was seen and found to be suffering from all the manifestations of thyroid deficiency. It was then found that through some oversight she had not been placed on thyroid extract since leaving the hospital. This was given, and she now feels quite well again. The wound is healed and is free from infiltration.

Gross examination of the specimen suggests the diagnosis of a sarcoma in the diffuse invasion of the thyroid gland by what appears to be tumor tissue. Only in the left lobe is any tissue recognizable as thyroid to be found. The peculiar rubbery consistency and the tracheal mould on the posterior surface of the tumor are striking features. The microscopic examination revealed widespread dissemination of miliary tuberculosis with considerable fibrosis.

#### TUBERCULOSIS OF THYROID GLAND

DR. ALEXIS V. MOSCHCOWITZ presented a patient whose history is as follows: approximately seven or eight weeks ago the patient who lives in Florida, arrived in New York City, and consulted his physician; he was advised to have his tonsils removed, as they were diseased. This was done by an eminent laryngologist under general anaesthesia. The convalescence after this operation was rather stormy. He ran some temperature for a number of days which did not reach the normal until the eleventh day; even then the remission was of very short duration, as he soon began to have evening temperature up to  $104\frac{1}{2}$ . He noticed a small lump on the right side of the neck which was exquisitely painful and tender, and interfered with deglutition so that the patient rapidly lost weight. In the absence of all other physical signs Doctor Moschcowitz was loathe to make a diagnosis of an abscess of the thyroid gland, for there was no fluctuation. He operated on the patient with this diagnosis and exposed the right lobe of the thyroid gland and aspirated various portions of it, but, to his chagrin could find no pus. He then incised the thyroid gland and found a densely hard infiltrating mass which involved the entire right lobe of the isthmus. In the best interest of the patient he decided to extirpate all of this infiltrated tissue and left only a small portion attached to the posterior capsule. The entire wound was left wide open. Within forty-eight hours the temperature came down to normal and the patient made a very prompt recovery. He has been gaining in weight approximately at the rate of a pound a day.

The tissue examined by Doctor Mandlebaum showed a diffuse miliary tuberculosis of the thyroid gland, with a superadded acute infection of some other nature. The bacteriological examination was negative. Finally it is but proper to add that this specimen was seen by another pathologist who did not know the history of the case and who pronounced it a lympho-granuloma of the thyroid gland.

DR. LEO EDELMAN (by invitation) said that sections taken from Doctor Neuhoof's specimen clearly show the typical miliary tubercle formation consisting of masses of endothelial cells with giant cells in the centre. Doctor Neuhoof's case undoubtedly falls within the group reported as caseous tuberculosis of the thyroid. This type forms a tumor, rather firm in consistency, growing rapidly in size, painful to pressure, with diffuse limits, and has a tendency to infiltrate neighboring tissues. The diagnosis is rarely made before operation. Localized areas of tuberculosis have been detected in a simple goitre without clinical or pathological symptoms. It is a known fact that the thyroid reacts to infectious processes in and about the throat. Doctor Moschcowitz's case showed a picture of the combined effects of tuberculosis and a toxic thyroiditis. The microscopic sections of a thyroid recently removed from a patient who presented the typical symptoms of Basedow's disease, gave confirmation of the diagnosis, but in addition there were found numerous miliary tubercles. The patient had no clinical manifestation of pulmonary tuberculosis. Some authors seemed to think that there was a definite relation between goitre, Basedow's disease and tuberculosis. Experimentally, however, it is most difficult to produce tuberculosis in a thyroid.

DOCTOR MOSHCOWITZ said that he believed that in the case he presented the diagnosis of an acute thyroiditis of an infective nature was justified in every respect. As to the pathogenesis and course of the infective agent, he was under the impression that the only logical way to explain it was, that the entire illness followed tuberculosis of the lingual tonsil which was also extirpated at the original operation and that the tubercle bacillus entered the thyroid gland through the isthmus which as is well known is embryologically connected with the lingual tonsil.

#### ACUTE PERFORATION OF GALL-BLADDER

DR. JOHN A. MCCREERY presented a woman, aged sixty, who was admitted to the First Surgical Division of Bellevue Hospital, March, 1922. Six hours before admission she had been awakened by severe knife-like pain localized in epigastrium and left upper quadrant of abdomen. Pain had persisted with original intensity until admission, but it gradually shifted to the right upper quadrant with radiation to the back, but not to the shoulder or lower abdomen. Following onset of pain she had vomited several times, vomitus consisting of greenish-yellow fluid with no blood. Bowels had moved once following onset, the stool being normal in appearance. There were no urinary symptoms; no chills or fever. Patient said she had never had any similar previous attacks.

Past history revealed somewhat indefinite symptoms of indigestion, covering a period of 15 to 20 years, the onset of these symptoms following menopause. Patient never had typhoid fever and had never been pregnant.

On admission patient's temperature was 98.2, pulse 56, respiration 18. White blood cells 14,100, with 86 per cent. polymorphonuclears. While evidently suffering severe pain, patient did not look acutely ill. Her abdomen



## GIANT-CELL TUMOR OF CLAVICLE

was rounded, did not move with respiration, and showed generalized rigidity, most marked in the right upper quadrant. Liver dulness was present. There was no evidence of free fluid.

At operation the gall-bladder was found thin-walled, the walls blue in color. On left side of the gall-bladder, about mid-way between the apex and base, at the point where the peritoneum was reflected to the lower surface of the liver, there was a perforation about 3 mm. in diameter irregular in contour. The surrounding bladder wall was not thickened. There was a moderate amount of fibrin between the gall-bladder and the lower surface of the liver in front of the duodenum. The upper part of the peritoneal cavity contained 8 or 10 ounces of thick bile, which was partly shut off from the lower abdomen by adhesions between the omentum and the abdominal wall. The pancreas, stomach and duodenum were apparently normal. No enlarged lymph-nodes were felt along the common duct.

A cholecystectomy was performed rather than a cholecystostomy, as it was felt that a closure of the perforation would be difficult and drainage unsatisfactory.

Her post-operative course was complicated by frank pneumonia and by disruption of the wound, as a result of which patient at present has a ventral hernia, adequately controlled by a truss, which at the present time gives her no symptoms.

The pathological report by Doctor McWhorter was that the gall-bladder was normal, except in the immediate region of the perforation, where the blood-vessels were thrombosed and the gall-bladder wall cedematous and infiltrated with leucocytes. Doctor McWhorter felt that the perforation was embolic in origin. Culture of bile and peritoneal fluid was negative.

While perforation of the gall-bladder is not rare, it practically always occurs in a gall-bladder which has been previously the seat of chronic inflammatory changes subsequent to cholelithiasis. In this case, however, the gall-bladder was previously normal and the perforation was an acute accident, apparently the result of an acute vascular lesion, the cause of which was not determined.

## GIANT-CELL TUMOR OF CLAVICLE

DR. FRANK S. MATHEWS reported the history of a woman, now fifty-three years of age, who was seen by him first ten years ago with a cyst of the left breast with clear contents. The breast only was removed. After operation the condition was reported adenoma, possibly adenocarcinoma. Nothing more was done. Five years later a small nodule occurred in the skin one inch from the original incision, which was excised and pronounced carcinoma, similar in type to the original condition in the breast. In the interval, patient has had lobar pneumonia and operations for acute appendicitis, prolapse of the uterus, and gall-stones. Ten months ago, patient fell, sustaining contusions of the left elbow and shoulder, following which she complained of pain of considerable severity located about the shoulder. An X-ray taken six months ago revealed nothing. Some time afterward, as a result of a slight

injury, the clavicle fractured. Doctor Mathews did not see her thereafter until three months ago, when another X-ray showed evidence of central tumor of the clavicle, with fracture at the junction of the inner and middle third of the clavicle. With the history of the breast tumor in mind, it was feared that this might be a metastases. Operation removed the inner half of the clavicle with surrounding soft parts. The tumor appeared solid and had expanded the bone, measuring about one and one-quarter inches in its longest diameter. Microscopic examination showed it to be a typical giant-cell tumor of the bone; and in this case as in many others of giant-cell tumor, there is a definite history of trauma, although in this case it was indirect, direct application of violence being to the elbow and tip of the shoulder.

#### PROGNOSIS OF GIANT-CELL SARCOMA OF THE LONG BONES

DR. WILLIAM B. COLEY read a paper with the above title, for which see page 321, *ANNALS OF SURGERY*, March, 1924, vol. lxxix.

DR. FRANK S. MATHEWS said that his first giant-cell tumor was treated conservatively in 1903, and remained well for as long as he was able to follow the case. Another case of giant-cell tumor of the tibia operated on twelve years ago has remained well until the present time. These cases were reported in a paper read before this Society entitled "Myeloma of Long Bones," a name which he adopted following Adami to call attention to their comparatively benign character. This was unfortunate, as pathologists are limiting the term "myeloma" to describe an entirely different class of tumors. There can be no doubt that there is a group of tumors occurring in the medulla of the long bones characterized by an abundance of giant cells of a particular variety and which is benign in its course. The point is debatable as to whether there is a second and smaller group of central bone tumors having giant cells, resembling the first group, and which is clinically malignant, and if there is such a class, it is a point of greatest interest to know whether pathologists of the present and future will be able to distinguish the benign from the malignant. Some of Doctor Coley's cases would lead one to think that even the best pathologists had differed regarding the malignancy of these tumors. Doctor Coley's own experience has been that nine out of fifty of these cases have shown metastases. Pathologists seem to think that the general surgeon has little information regarding the pathology of these tumors. One pathologist has considered it a demonstration of their ignorance because several surgeons in a particular case recommended amputation. It is not clear, however, that the recommendation was the result of ignorance of the course of these tumors but may have been based on an opinion that the member would be practically useless after local destruction of the tumor.

DR. H. H. M. LYLE said that he had observed, in his own cases, a preponderance of women over men; out of eight cases, seven were women. Out of the five cases shown by Doctor Coley this evening there was only one man. He wanted to know the incidence of male and female. Regarding the closure of the large bony cavities after curetting, Doctor Lyle has been

## PROGNOSIS OF GIANT-CELL SARCOMA OF THE LONG BONES

able to save a great deal of time by filling these cavities with attached muscle flaps; this allows of immediate closure. He has also tried free fat graft, but his results with these have been poor.

DR. HOWARD LILIENTHAL said that it appeared to him impossible to make an accurate diagnosis of malignancy without operation unless there were metastases. It had been clearly shown that a malignant tumor might remain localized for a number of years. The history of the case, combined with röntgenograms, might lead one into error. In one case from the speaker's experience, diagnosis had been made of giant-cell sarcoma of the lower end of the tibia principally on the evidence of the röntgenogram. The thinness of the bone, however, made it necessary to operate and believing the case to be non-malignant, Doctor Lilienthal had removed it with a large, sharp curette down to what looked like healthy bone. Doctor Mandlebaum reported that the specimen was one of extremely malignant osteosarcoma. It appeared to the speaker that with Doctor Codman's figures in mind, amputation would probably be worse than useless. Radium could be of but local benefit, these cases almost invariably metastasizing. On account of the speaker's results with Coley's toxins, he advised their employment. They were used and about two years after operation the patient was apparently well and walking. Doctor Lilienthal said that there was less danger in making an operative diagnosis in these cases than to treat them symptomatically, provided the tumor was solitary. He thought that it would be well not to amputate with the idea of saving life, but perhaps for some other reason, such as the size of the tumor or unbearable pain. He also again emphasized the importance of toxin treatment.

DR. GEORGE WOOLSEY said that he had seen more giant-cell tumors in the lower end of the femur than in any other bone. The first case, involving the inner condyle, he operated on in 1910 with curettage and carbolic acid and in eight months it recurred and then involved the entire lower end of the femur. He curetted again and shortly afterward, as there was great vascularity and much oozing and the patient wanted to be rid of it, he amputated and the patient had had no recurrence. The first pathological report was giant-cell sarcoma with many spindle cells. This case was not like others he had seen; the lining of the cavity was not smooth and composed of a thin layer of bone, but rough cancellous tissue. It also pulsated. When the specimen was examined it was very vascular, with spindle cells and giant cells and was diagnosed bone aneurism. Two other cases had been operated on by curettage and cauterization by carbolic acid and then had been treated by X-rays. One has remained well for eight years. The other, quite an extensive case, involving the entire inner condyle, was operated about 6 months ago. The cavity is now filled up and the patient has perfect use of the leg.

DOCTOR COLEY, in closing the discussion, said that he believed Doctor Mathews and himself were practically in accord in regard to the prognosis of giant-cell sarcoma. He agreed with Doctor Mathews that the majority of giant-cell sarcomata were benign or only locally malignant